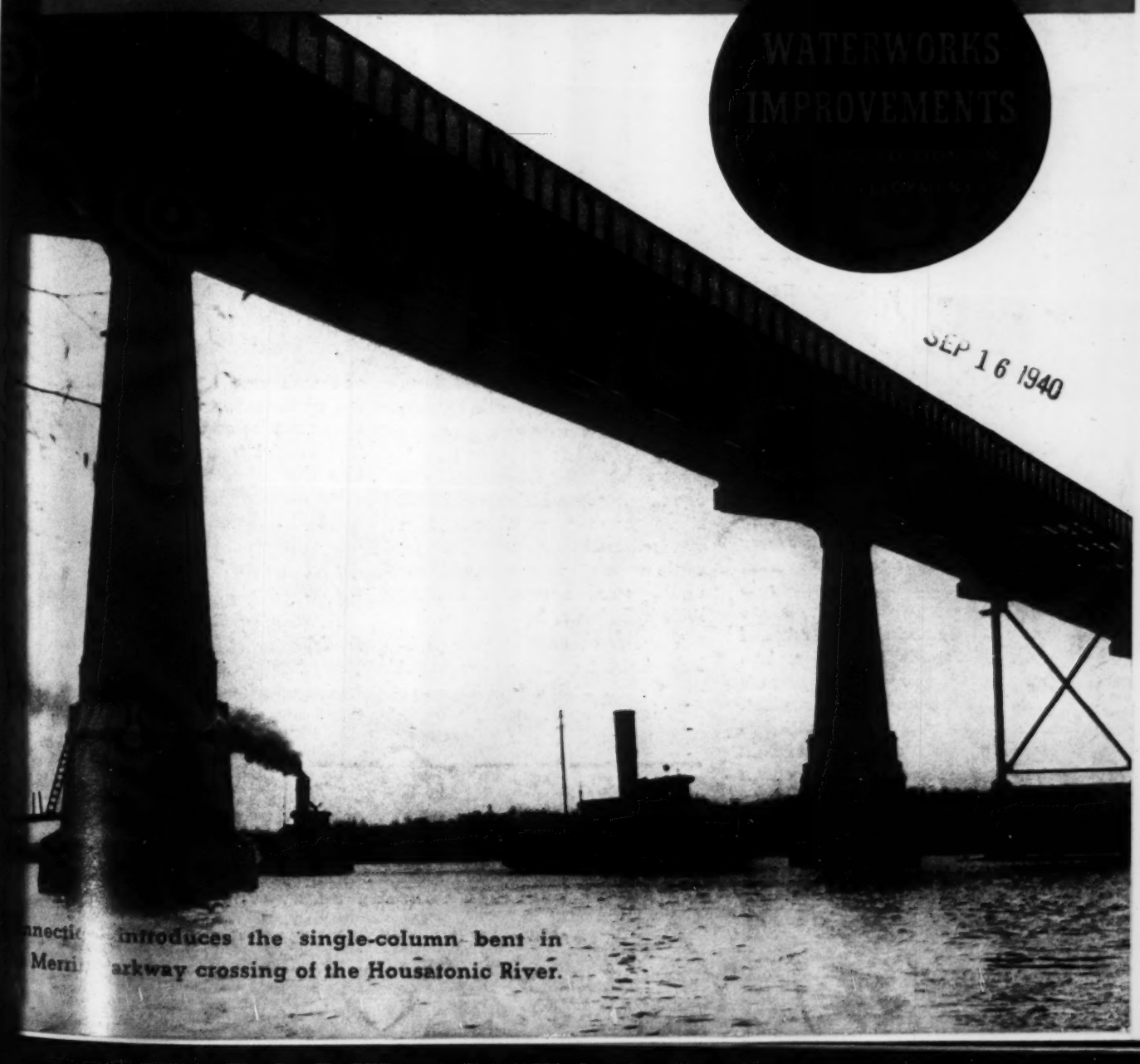
ENGINEERING NEWS-RECORD

SEPTEMBER 12, 1940

WATERWORKS IMPROVEMENTS

SEP 16 1940



...nnecti... introduces the single-column bent in ... Merri... arkway crossing of the Housatonic River.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

A suburb with Central Heating sounds like the dream of some modern housing-project designer . . . yet one has existed near Cincinnati, Ohio, since the middle 1920's. Mariemont, an unincorporated residential village constructed by the Thomas J. Emory Memorial, has a central heating plant with sufficient capacity to heat three-fourths of the entire town. Three and one-half miles of mains distribute the steam. The most distant point on the system is over 6,000 feet from the plant. The mains are insulated with two layers of asbestos and one of bright tin, and enclosed in hollow wooden logs, which were roofed with heavy tar paper before backfilling.

These lines have been in use for 14 years, and the chief engineer reports them "Still in perfect condition." They are wrought iron.

The use of underground heating lines brings very definite corrosion problems, which wrought iron is particularly fitted to solve. To cite two examples—a 14" underground steam line of Byers Wrought Iron was installed at Iowa State College, while wrought iron was used for underground hot water heating lines by LaPorte, Ind., Utility.

Write us concerning your problems involving the underground distribution of heat. Our Engineering Service Department will provide you with case histories covering the performance of wrought iron under similar conditions. You will find helpful information concerning the corrosion problems encountered in many services, and the best ways of solving them, in our bulletin, "Wrought Iron for Piping Systems." May we send you a complimentary copy?

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

BYERS GENUINE WROUGHT IRON

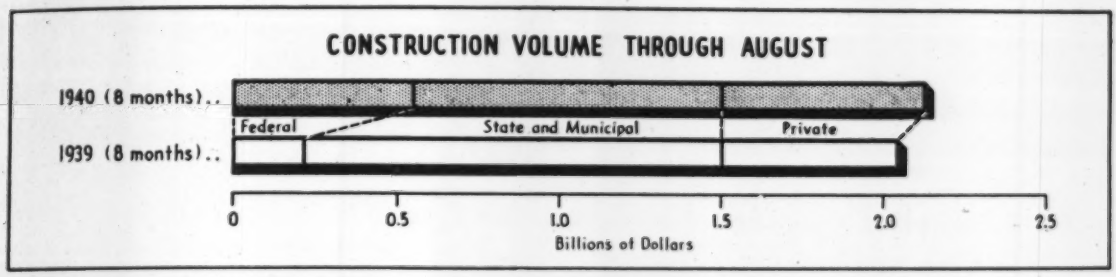
TUBULAR AND FLAT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

Spectacular gains result from defense spending



TWO CONSECUTIVE months of spectacular activity on the national defense program have brought total construction awards from a point 11 per cent below 1939 at the end of the half to 4 per cent above last year at the end of August.

The two months added almost three quarters of a billion dollars to the construction total—$347,852,000 in the four weeks of July, and $397,253,000 in the five weeks of the month that has just passed.

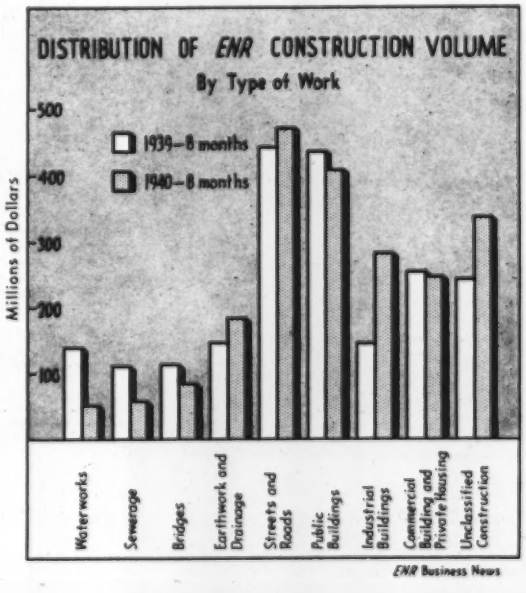
Public construction initiated almost 80 per cent of the two-month volume, and as a result, pulled up even with the 1939 eight-month total from a level 23 per cent below at the end of the first six months.

Private construction, though not quite maintaining its 24 per cent gain at the half, is reported 16 per cent above the 1939 total through the eight-month period.

Powder plants for the War Department, barracks, temporary housing and other public buildings for defense, coupled with airports, naval bases and shipbuilding facilities included in *ENR* unclassified public construction carried off top honors in the public field. The public building total was 49 per cent below a year ago at the half, but by the end of eight months had climbed to within 11 per cent of the 1939 period's record volume.

The most pronounced rise in any class of work occurred in unclassified public construction. From a position 30 per cent under a year ago at the end of the half it has jumped, in the brief space of two months, to a gain of 134 per cent over the volume reported for the eight-month period last year.

With defense work in stride, this public construction is due for important gains.



ENR Business News

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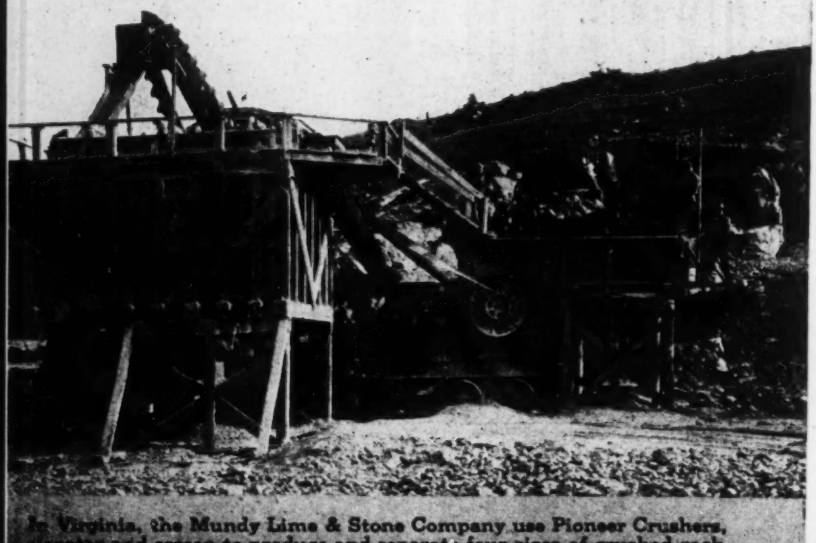
In Oregon, McNutt Bros. of Eugene, use a Pioneer Quarry Plant with a 2436 Primary Jaw Crusher and two Roll Crushers to produce six sizes — control the amount of each and recrush any excess.

SAVE ON QUARRY AGGREGATES

In Maryland, Garrett County uses two Pioneer No. Quarry Plants to produce their road surfacing materi

In Texas, Ernest Loyd of Fort Worth, uses a Pioneer Quarry Plant with Traveling Grizzly Feeder — 2436 Jaw Crusher and Roll Crusher to crush and screen caliche.



In Virginia, the Mundy Lime & Stone Company use Pioneer Crushers, elevator and screen to produce and separate four sizes of crushed rock.

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • SEPTEMBER 12, 1940

Housing Confusion laid to USHA fight with Congress

Dwelling units totaling 7,475 in construction stage and 2,863 more scheduled for an early start.

The confused legislative situation on defense housing does not so much reflect a real confusion in planning for housing for defense workers as it does an offside fight between USHA and its congressional opponents. The Housing Authority is extremely unpopular in the House—partly because of actual opposition to subsidized housing and partly because of anger at USHA's inept lobbying and sly accounting.

The legislative confusion is great. Already law is a measure (*ENR*, July 11, p. 57) empowering USHA to build almost any type of defense housing. No money has ever been appropriated under this authority; USHA has about $150,000,000 which it could probably use, but it is holding off because it wants to have subsidy money available, for the future at least, on any money it spends.

Pending before Congress is an entirely different authorization, worked out by defense housing coordinator Palmer and therefore having "official" status. This would put the responsibility for government-owned defense housing under the Federal Works Administrator operating through the Public Buildings Administration. This bill authorizes an appropriation of $150,000,000. There is a loophole in the bill by which other FWA agencies, including USHA, could be brought into the program.

Independently of these bills, an appropriation for defense housing has been included in the five billion dollar supplemental defense bill, just signed. This money is assigned to the Army and Navy, which agencies may utilize the services of any agency of the government—presumably FWA. It has not yet been determined whether this money will be applied against the $150,000,000 authorized in the coordinator's bill or whether it will be treated as additional money. The latter course is favored by the administration, which would like to see this money used for housing Army and Navy employees, while the money authorized in Palmer's bill would go to house defense industrial workers.

What has happened, essentially, is that the Housing Authority has been working through its senatorial friends, particularly Wagner, to take charge of the entire program. Meanwhile the administration has been trying, in deference to Congressional susceptibilities, to minimize USHA's participation. Probable outcome is that USHA will be restricted to the subsidized phase of defense housing. A substantial volume of subsidized dwellings will be needed, particularly for married enlisted men, whose income in many cases is less than $1,000 a year. And in any case the administration, for social reasons, is anxious to keep the principle of subsidized housing alive.

But behind this political jockeying, real progress has been made on getting housing going. USHA, first in the field, has cleared 17 projects costing $28,675,000 and providing 7,475 dwelling units, of which several are already under construction. Four are being handled by Army or Navy and the rest by local housing authorities. Seven other projects, involving 2,863 units, are scheduled for an early start.

Money for these projects, all in the form of 100 per cent loans, was obtained either from previous earmarkings to

Bronze tablet credits constructors at Hansen Dam

Formal dedication exercises on Aug. 17 marked completion of Hansen Dam, major unit of the $70,000,000 Los Angeles County Flood Control system, more than a year ahead of schedule, Dec. 7, 1941 being the limit specified in the contract.

The rolled-earth structure, ENR, April 11, 1940, p. 497, is a horseshoe dike with a length of 10,509 ft. and a maximum height above stream-bed of 122 ft. Maximum thickness of the base is 1139 ft, and a total of 14,000,000 cu. yd. of earth was used in compacting the fill. The spillway structure is of reinforced concrete, and ten outlet openings are provided, eight of which are not fitted with gates, but remain open continuously, the dam being purely of a regulatory nature, not intended for storage.

The dam will regulate the flow of Big and Little Tujunga Washes, the 50,000 cfs flow from which was one of the major causes of disaster in the flood of March, 1938, on the Los Angeles River.

these communities, from economies, or by cancelling outstanding earmarkings on which there have been delays. Although no arrangements have been made to subsidize these projects, the authority is available and could be used either at once or at a later date when the defense emergency is over. All the projects are being built to regular USHA standards.

On another front, the FHA rental division is being brought in. The President has turned over $10,000,000 from his "blank check" emergency fund to the RFC Mortgage Corp. The corporation, operating like any speculative builder, will use this money to meet the 20 per cent down payment on FHA insured apartment houses—thus providing about $50,000,000 worth of housing. No projects have been put under way as yet, but several are in preparation. It is hoped that when the buildings are completed, the corporation can sell its equity to private investors and thus create a revolving fund. The corporation could either retain architects and engineers to carry out its projects, or, after the coordinator's bill passes, use facilities of the Public Buildings Administration.

Meanwhile, the housing coordinator has been setting up a staff and making detailed surveys of the defense need for housing. In most cases this resolves itself into a determination of the number of families to be brought into a community from outside, since all over the country vacancies appear to be negligible. Preliminary estimates indicate immediate need for about 130,000 dwelling units—50,000 for Navy employees and married enlisted men, 40,000 for the War Department, and 40,000 for industrial workers in defense industries. The last figure is subject to considerable upward adjustment.

Real efforts are being made to induce private builders to go ahead and meet the local needs. Realtors, bankers, and civic leaders in communities experiencing shortages are being told that the defense boom may well prove not as temporary as they think, that if they don't do the job the government will and they'll wake up faced with government competition. How much of the housing need will be met privately depends on the success of these efforts.

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Floods prompt railroad abandonment request

Because of disastrous floods in Western North Carolina in August, the Linville River Railway Company has petitioned the Interstate Commerce Commission in Washington that it be allowed to abandon 31.5 miles of its line from Cranberry to Boone, N. C. It said that replacements would cost around $50,000, and that this is unjustified.

President asks $9,000,000 for defense short course program

Engineering colleges expected to participate in special training

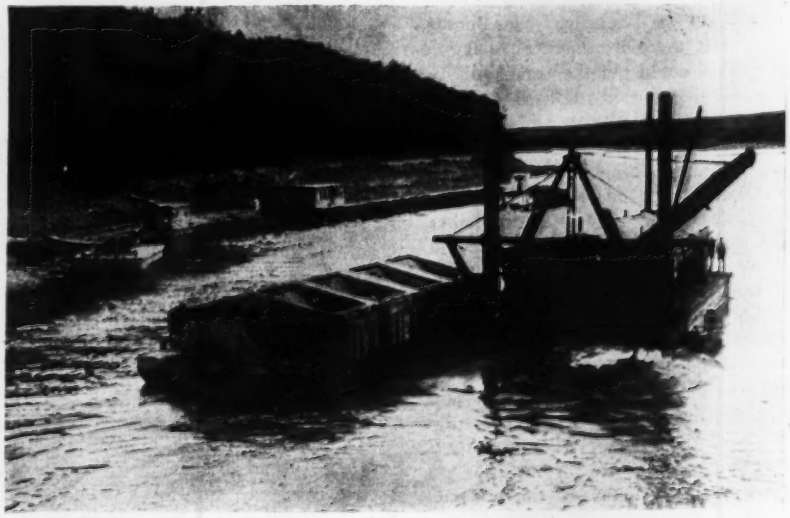
The program for training of specialists needed by the defense program in short courses to be offered by the nation's 155 engineering schools has been more or less dormant since it was first proposed in June. Last week, however, it came to life when the President asked Congress to appropriate $9,000,000 to carry the program through the coming school year. At the same time an advisory committee, headed by Dean A. A. Potter of Purdue University, was named by the U. S. Office of Education to aid in setting policies. Actual administration of the program will be the responsibility of Allen W. Horton, Jr., of the Office of Education, who is also secretary of the advisory committee.

The plan is for the engineering schools to offer courses varying in length from one to eight months by which engineering graduates might be trained to do the particular work required for defense. Thus a civil engineer might be trained in a four-month course in the structural design of airplanes, or a mechanical engineer might take a four-month course in airplane engines. The courses would be additional to the regular work of the schools. The cost would be met out of the federal appropriation, and no tuition would be charged. It might be necessary in some cases to enlarge present faculties, but since engineering enrollment has fallen off sharply this year it is believed that the work could mostly be handled with present staffs.

Particular courses to be offered at each school would depend primarily upon the needs of the defense industries in its area. According to Commissioner of Education Studebaker, marked shortages exist in naval architects, ship draftsmen, marine engineers, airplane structural, engine, and instrument experts, machine tool designers, and production engineers. An early shortage is expected of material inspectors, and there may be need for more radio equipment inspectors, structural and machine designers, metallurgists, sanitary experts, meteorologists, and experts in aerial photography and mapping.

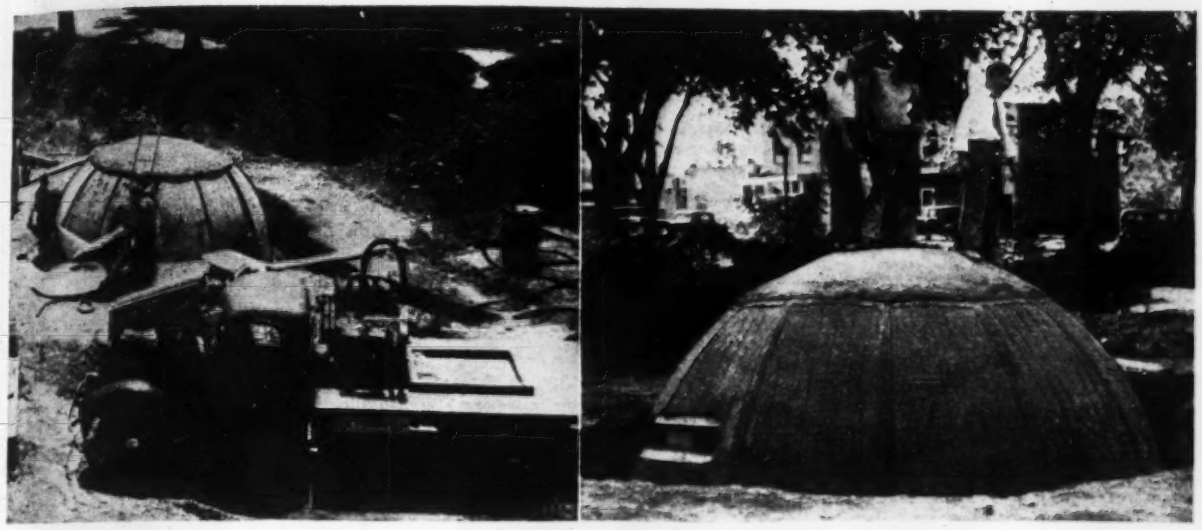
Selection of students to take the courses would be handled by the individual schools. Cost per student is estimated at about $80 per month; the average course would last about three months.

The President has also asked for $44,000,000 to continue the present program of vocational school training under which about 75,000 men are now receiving courses of less than college grade. Money for both programs is expected to be included in a third supplemental defense appropriation which will be presented to Congress after the conscription bill is passed.



Job assembled equipment improves Canadian navigation

First dredging work done in the arctic waters of Canada has been completed on the Athabasca River near Fort MacMurray, Alberta. The Cummins Construction Co. of Montebello, Quebec, did the work for the Department of Public Works of Canada. All freight for the Mackenzie basin moves through this route by steamer.



Demonstration Pillbox Built in 5 Hours

Containing approximately 25 yd. of concrete, weighing 50 tons, and costing less than $500, this concrete pillbox of 15-ft. outside diameter with walls more than 2 ft. thick, was recently built in 5 hours as a demonstration in Washington. A 6¼-bag mix of ordinary portland cement of 3-in. average slump was used but no reinforcing steel.

Designed by Karl P. Billner, President of Vacuum Concrete, Inc., of Philadelphia, the pillbox is claimed to permit ready use of the advantageous dome shape, and to expedite and simplify construction. All of the equipment necessary can be operated by unskilled labor.

The equipment consisted of a vacuum processing thin rubber inside form, a vacuum processing sheet metal outside form in twelve sections, a rubber vacuum mat to process the top of the dome, a truck-mounted compressor which was also used as a vacuum pump, and miscellaneous accessories.

When the truck arrived at the previously excavated site, the inside form was inflated to an air pressure of 4 lb. per sq.in., and rolled into position, the sections of the outside form were placed and bolted together, and a combined spreader and stabilizing ring laid on top of the inside form. Form erection took one hour and concrete placing followed immediately. A weak gypsum cement mix temporarily filled the gun slits.

Vacuum processing was begun when concrete approached the top and was completed close behind the puddling. Placing and vacuum processing required 3 hr. followed shortly by stripping. This consisted of removing the top vacuum mat, exhausting the inside form and removing it through a 2-ft. trench under the pillbox, and unbolting and removing the outside form sections. The elapsed time was 5 hr. from the start of forming to completion of the dome shaped pillbox shown at the right.

Louisiana reorganizes its highway department

Reorganization of the Louisiana Highway Commission into a Department of Highways was effected August 29 by executive order of Governor Sam H. Jones. The revision is part of a sweeping realignment of the state government in which 170 agencies are consolidated into 20 departments. The highway department is affected only superficially despite campaign talk of extensive changes.

W. Prescott Foster, of Franklin, La., previous chairman of the commission, became director of the new department whose board includes W. H. Hodges, of Elm Grove, La., chairman, W. E. Gilbert, of Wisner, La., a member of the old Commission; and Elmer E. Shutts, of Lake Charles, La., a well known consulting civil engineer.

Harry B. Henderlite, who has been state highway engineer for several years, was designated chief engineer and head of the entire engineering division. R. B. Richardson, former construction engineer, will head a combined construction and maintenance subdivision; H. A. Flanakin, traffic and planning; Harry Waugh, road design; N. E. Lant, bridge design; J. A. Kinkead, project control; G. J. Bailey, maintenance standards; and W. C. Shanckle, equipment.

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Ruling given on Texas road bond fund

A road must be part of the state highway system to participate in the Texas state road bond assumption fund, according to a recent ruling of the attorney general of that state. The fund, created by the Texas state legislature which last year reenacted a road bond bill previously passed, allocates one cent of the four-cent state gasoline tax for payment of bonds issued by counties and road districts. In adopting the bill, the state legislature had attempted to include those roads which the highway commission "had indicated its intention to designate as a part of the state road system prior to Jan. 2, 1939."

Conditional designation of a road as part of the system was held by the attorney general to be insufficient to qualify a road construction project for participation in the bond retirement fund.

The question of participation was raised by the board of county and road district indebtedness on a petition for participation for a section of State highway 191 (U.S. 283) from Albany to Coleman, and a section of State Highway 103, which extends east and west from Lufkin.

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Funds provided for roads in Grand River Dam area

The state of Oklahoma has agreed to spend $1,373,000 to replace roads and bridges being inundated above the Grand River Dam, now nearing completion, according to Governor Phillips, who states that details have been agreed upon and that PWA approval is awaited. Allotment of funds for the work by the PWA is considered likely, inasmuch as the state is paying for more than half.

WASHINGTON HIGHLIGHTS

THE HOUSE this week passed a bill authorizing the Navy to build two new drydocks, capable of handling the largest ships, on the Atlantic seaboard, and to improve an existing dock at South Boston. One dock at New York harbor would cost $10,000,000; the other in the Carribbean area, $7,500,000. Rehabilitation of the now unused South Boston dock will cost $6,180,000. No money is now available for this work, but it is expected that the funds will be included in the third supplemental defense bill, which will be introduced after conscription is passed. The House measure takes the place of a Senate bill providing for cooperative construction of the New York dock by Navy and Port of New York Authority.

AS SIGNED by the President this week, the $5,000,000,000 second supplemental defense appropriation included $100,000,000 for defense housing (see page 61) $128,000,000 for temporary barracks construction, and an additional $6,000,000 of Navy Public Works but otherwise conformed in the main to the version originally passed by the House.

A SENATE amendment, accepted by the House, brought the Corps of Engineers into the defense program for the first time. The clause permits the Secretary of War to assign to the Engineers any of the defense construction which is now the responsibility of the overloaded Quartermaster Corps. Another change waives the requirement of payment and performance bonds for contractors holding Army fee contracts.

The $128,000,000 for temporary barracks is intended to provide shelter for about 95,000 men of the expanded regular Army, about 200,000 National Guardsmen, and about 100,000 drafted men—those who will be used to fill in National Guard units. About half will be located south of North Carolina; they will be under canvas on wooden platforms. With utilities this type of shelter costs about $285 per man. The other half, in the North, will be housed in standard wooden barracks costing about $400 per man. This work has already been started by means of an advance from the President's "blank check" fund, which will be repaid from the present appropriation.

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Oklahoma has flash floods

Torrential rains which measured from 4 to 10 in. in a 12-hr. period caused flash floods in northwest Oklahoma on Sept. 4. Major damage was confined to areas along the Arkansas and Cimarron rivers in the vicinity of Tulsa, Bristow and Cleveland. At the latter place the city lost its source of water supply when an earth dam was washed out. The Arkansas River rose from 1.65 ft. to 14.6 ft. in eight hours. And at Tulsa the Army engineers reported that it finally reached 16-ft. flood stage.

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Martin plane factory addition underway

Ground was broken at Baltimore Sept. 4, by Glenn L. Martin, pioneer aircraft manufacturer, for the first in a series of plant expansions which ultimately will increase the company's present floor space of 1,263,000 to 3,000,000 square feet. This is the first ground broken in the national defense expansion program as the Martin company begins preparation for mass production of airplanes. This first increment of expansion is being financed with the company's own funds. Speaking at the ceremony, Mr. Martin remarked that his company is going ahead in the expansion of its plant and facilities without waiting for the legislative situation to clear up. The first plant expansion will give the company around 400,000 square feet of additional floor space for the extension of its huge "Navy Bay," largest aircraft assembly floor in the U. S., and the famous "C" building which was built last year in 77 days for a world record construction. (*ENR* June 22, 1940, p. 834)

Dam failures caused freak floods in Jersey

Week long rain climaxed by deluge results in heavy runoff

Nature, in one of its capricious moods, brought floods to the flat-lying and sandy coastal plain of southwest New Jersey on September 1. In this area of small, meandering streams, most of which are dammed at frequent intervals to provide ponds for recreational use and water-wheel operation, a deluge fell on ground saturated by a week of rain. Heavy runoff which washed out upstream dams, released waves of water in already swollen stream beds to destroy highway and railway bridges and sections of roads.

It is stated that state highway damages amounted to a half million dollars. Estimates of damage reported in newspapers ranging from 4 to 10 million dollars, appear to be greatly exaggerated, according to a member of the ENGINEERING NEWS-RECORD staff who travelled through the region.

Bridgeton, on the Cohansey River, had two dam failures on recreational lakes, which resulted in the flooding of its municipal water plant. Discharge from the biggest lake downstream was being carried off satisfactorily until the earth-fill gave way on a dam upstream. The resulting wave of water topped the lower dam and washed out a 500-ft. section of its 1,200-ft. length. It took 10,000 cu.yd. of fill to repair the breach.

JOBS OF THE WEEK

AIRCRAFT ENGINE PLANT, East Hartford, Conn.

Turner Construction Co., Boston, Mass., was awarded a contract for an aircraft engine plant, for the Pratt and Whitney Division of the United Aircraft Corp., East Hartford. Total estimated cost $2,000,000. Albert Kahn Inc., Detroit, Mich., engineer.

HOUSING PROJECT, Detroit, Mich.

A. Smith & Co. and Lipman Construction Co., Chicago, Ill., were awarded the contract for constructing S. James Herman Gardens housing project at $8,330,000.

WAREHOUSE, Chicago, Ill.

John Griffiths & Son, Chicago, Ill., were awarded a contract for constructing a warehouse at Sacramento Ave. and Franklin Blvd., for Sprague Warner Co., Chicago, Ill., at $2,000,000. A Epstein, Chicago, Ill., is the architect and engineer.

BANK AND OFFICE, San Francisco, Calif.

Cahill Bros., San Francisco, Calif., were awarded the general contract for 12-story and basement bank and office building for Bank of America, National Trust and Savings Assoc., San Francisco, Calif., at $2,000,000. L. H. Nishkian, San Francisco, is structural engineer and G. M. Simonson, San Francisco, mechanical engineer.

BULKHEAD WALL, New York, N. Y.

Reiss and Weinsier Inc., Brooklyn, is the lowest bidder at $1,386,739 for constructing a bulkhead wall and sewer between E. 41 and 49 Sts., along East River as part of the East River Drive to extend eventually from the Battery to 125th St. Work is for the Borough of Manhattan.

NOTE—Additional bidding and contract news on over 600 projects, large and small, appear in the Construction News Section beginning on page 163.

according to E. H. Maier, city engineer. A new siphon spillway and bridge at one end of the dam was unharmed.

The 3 mgd water filtration and pumping plant, a mile below the dam, was flooded to a depth of 4½ ft. Fortunately, the city had just completed the installation of a new groundwater supply which was quickly available.

Millville misses catastrophe

Serious damage was averted at Millville where a power canal, fed by the largest lake in South Jersey (Union Lake) threatened to overflow its banks. The canal, which passes through the center of town, was piled high on each side with sand bags to confine the water which was not passed by the 150 ft. long and 8 ft. deep spillway.

Union Lake, like others in the effected area, was already filled to capacity when smaller dams above it gave way. The new concrete bridge on the stream below the dam spillway withstood the onslaught of the flood waters, although it was overtopped.

The Salem River went on a rampage at Woodstown, taking out two timber railroad trestles, two county bridges, and a state highway bridge. Damage to the latter, a 50-ft. reinforced concrete structure on Route 45, was made complete when a spherical gas tank floated down the stream and was jammed into the bridge. This plugged the channel-way, which resulted in the scouring out of bridge abutments and approaches.

According to John N. Brooks of the New Jersey State Water Policy Commission, the causes of the floods may be laid to the progressive failure of small upstream dams. Many of these are very old, some dating back to Colonial days. The week-long rain which preceded the torrential downpour of September 1 (unofficial figures showed this as high as 10 in. in 8 hr.) not only saturated and thus weakened the earth dams, but contributed to an unusual runoff.

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Philadelphia water project names engineers

John H. Neeson, public works director of Philadelphia, recently announced the apopintment of five engineers to prepare plans for the $18,000,000 rehabilitation of Philadelphia's water system, construction of which is expected to start early in 1941. Appointees are: William C. Rudd, electrical and mechanical engineer on pump design, who comes from the Detroit department of water supply; Eugene A. Hardin, engineer on filter plant design; G. Gale Dixon, principal assistant engineer, formerly with TVA and the Morgan Engineering Co.; George L. Bean and William H. Crawford, both of Philadelphia, assistant engineers on filter design. The city council has allocated $250,000 for advanced planning and design.

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Santee-Cooper project gets additional funds

Because of the importance of the Santee-Cooper Power and Navigation project to the national defense, the Public Works Administration has made an additional $5,000,000 available for construction. The new allotment brings the total PWA funds available for the project to $39,300,000 of which 45 per cent is a grant and the remainder a loan represented by bonds of the Authority.

The additional funds will off-set possible increases, due to the defense emergency, in estimates of the cost of contract work not yet awarded. The funds will also be available for the construction of transmission lines which will carry the project's low cost power to the areas which will be served by the South Carolina Public Service Authority, builders of the project.

Construction of the vast South Carolina project is now 35 per cent complete and generation of power is expected to begin in the fall of 1941. A description of the project appears in *ENR* May 23, 1940, p. 706.

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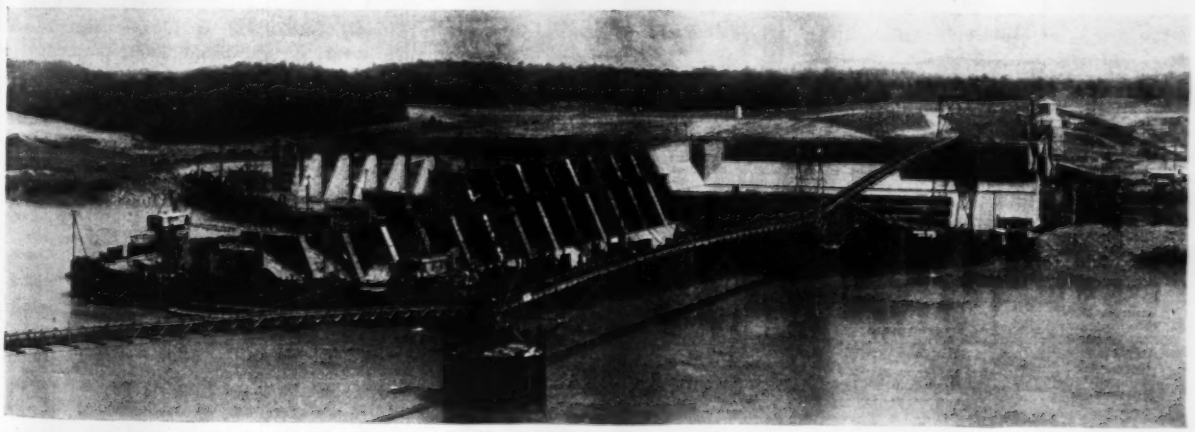
Sabotage defense aid

Federal Bureau of Investigation advice on how to guard defense plants against sabotage is now available to business and industry for the asking but will not be formally announced because the amount of service which can be given is limited. Responsible officials of any plant vital to national defense may request FBI to make a survey including expert analysis of "weak spots" in factory setup and existing protective measures, and recommendations of what should be done. Specially-trained sabotage agents are available for these studies. Their recommendations are not binding upon the company requesting them, and will be kept strictly confidential.



TVA prepares for increased power demand by rushing work at Watts Bar Dam

About 275,000 yards of concrete have been placed in TVA's 6th major dam, midway between Chattanooga and Knoxville on the Tennessee River. Controlled flood storage is 370,000 acre-ft.; normal head 56 ft.; generating capacity, 90,000 kw. for the initial installation of 3 of the 5 ultimate units. Concrete section of dam is 1770 ft. long including the 60x360 ft. navigation lock. Earth embankment adds 1200 ft. to the length on one bank. The suspension bridge shown in the foreground is for pedestrian use only.

Fred Schlemmer is project manager for both the dam and the 120,000 kw. steam plant being built nearby. Oren Reed is construction engineer on the dam and F. E. Bell on the steam plant. J. S. Lewis is construction superintendent on both jobs.

OBITUARY

LEONOR F. LOREE, 82, who rose from an $8 per week job as surveyor's assistant to leadership of a transportation empire died Sept. 6 at West Orange, N. J. A graduate of Rutgers, Loree passed sixty years at railroading. He was a contemporary of James J. Hill and Edward H. Harriman and, like them, was an apostle of rugged individualism. He was president of the Delaware & Hudson R.R. for 31 years and chairman of the board of the Kansas City Southern, and has held high offices with many other roads. He headed the New York Chamber of Commerce in 1928-30 and is author of the book *Railroad Freight Transportation*.

FREDERICK A. LEWIS, 82, died Aug. 31 at Charlottesville, Va. Lewis was a prominent engineer in the Portland Cement industry supervising the erection of cement plants throughout the country.

CAPTAIN OTHO C. KEAN, 59, chief executive and engineer of the Philadelphia Ordnance District, died Aug. 30 at Philadelphia. He was a graduate of V.M.I. and the U. S. Military Academy and subsequently taught at West Point.

EDWIN F. WILLIAMS, a builder for over 50 years, died in Scranton, Pa. Sept. 5.

HENRY R. DAVIS, 69, built more than 100 homes in the Cleveland west side, died recently at Maple Lake, Ontario.

EDWARD J. DUNNIGAN, 43, vice president of the A.G.C. of Minnesota and a director of the national A.G.C. died recently in St. Paul. Dunnigan had headed his own construction organization since 1917.

LARS OLSON, 73, who retired two years ago as chief engineer of the Spring Water Co., Kane, Pa., died Sept. 2.

WILLIAM H. MASON, 63, of Laurel, Miss. and inventor of the Masonite process died at Mayo Clinic, Rochester, Minn. Aug. 24.

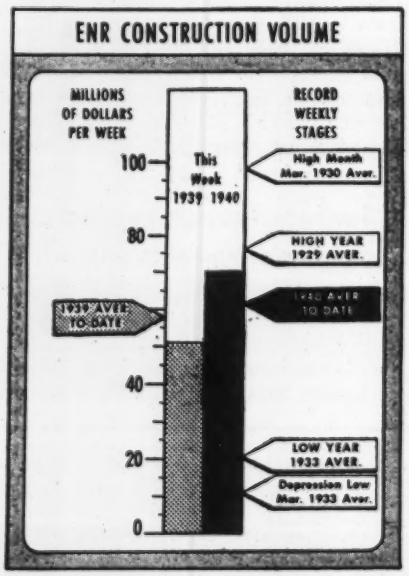
WILLIAM C. FAWCETT, 80, location engineer for the Ohio State Highway Department from 1922 until his recent retirement, died Sept. 3 at Columbus, Ohio.

HENRY C. STEINBACH, 56, construction engineer of Duluth, Minn., died recently at his home at Lake Vermilion.

CONTRACTS AND CAPITAL

PRIVATE ENGINEERING construction steals the spotlight for the current week, record increases in both industrial and commercial building to bring the volume to the fourth highest of the year. The private total tops the corresponding week last year by 137 per cent, while public construction, the leader for the past two months, is 2 per cent under 1939.

The week's construction total, $68,705,000, is 36 per cent higher than a year ago, and brings the total for 1940 to date to $2,279,987,000, an increase of 6 per cent over the 37-week 1939 volume. The 1940 private awards exceed last year by 20 per cent. Public construction maintains its 0.6 per cent gain over a year ago as a result of the 152 per cent increase in federal work.



The two classes of construction responsible for the private gain, industrial and commercial building, reached their third highest volumes of the year. In addition to these classifications, bridges and unclassified construction also report gains over the short preceding week; and bridges, public buildings, streets and roads, and unclassified top their 1939-week totals.

New capital for construction purposes for the week totals $91,992,000. This compares with $1,472,000 for the week last year. The current week's total is made up of $78,500,000 in RFC loans to private industry, $11,075,000 in corporate issues, $2,117,000 in state and municipal bonds, and $300,000 in RFC loans for public improvements.

The high volume of new construction capital added during the past two weeks has brought the 1940 37-week figure to $2,523,270,000, a 17 per cent increase over the $2,155,720,000 reported for the period last year.

(*Weekly table on page 59*)

Engineering Construction Contracts Reported by Engineering News-Record, in August, 1940

Engineering News-Record *reports projects of the following minimum costs:—water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Five Weeks — Thousands of Dollars (000 Omitted)

							United States			
							August	Eight Months		
Public Works	**New England**	**Middle Atlantic**	**South**	**Mid West**	**West of Mississippi**	**Far West**	**1940**	**1940**	**1939**	**Canada**
Waterworks	319	1,386	850	734	2,083	529	5,901	53,780	140,042	301
Sewerage	723	2,927	462	1,947	1,612	650	8,321	59,375	114,494	70
Bridges, public	57	9,358	1,079	1,545	1,944	1,008	14,991	73,725	110,604	432
Earthwork and waterways	2,332	5,265	12,689	1,691	12,876	3,744	38,597	183,343	147,778	796
Streets and roads	1,642	14,500	7,640	14,241	15,711	4,743	58,477	476,648	445,034	4,672
Buildings, public	5,921	20,065	62,366	37,922	7,537	6,336	140,147	394,304	441,052	8,015
Unclassified, public	6,331	6,559	5,892	3,743	4,468	21,060	48,053	257,986	110,182	13,133
Total public	**17,325**	**60,060**	**90,978**	**61,823**	**46,231**	**38,070**	**314,487**	**1,499,161**	**1,509,186**	**27,419**
Federal government (included in above classifications)	10,990	17,250	71,659	28,099	15,688	26,656	170,342	557,990	218,893	.....
Private										
Bridges, private	.....	.....	.....	.....	435	.....	435	10,190	4,881	.....
Buildings, industrial	2,072	10,883	7,277	4,864	10,225	6,991	42,312	284,287	146,341	16,729
Buildings, commercial	3,790	12,391	5,002	4,701	1,725	2,394	30,003	250,603	258,050	400
Unclassified, private	73	2,251	2,321	2,103	3,015	253	10,016	90,480	137,457	220
Total private	**5,935**	**25,525**	**14,600**	**11,668**	**15,400**	**9,638**	**82,766**	**635,560**	**546,729**	**17,349**
Total Engineering Construction:										
August, 1940 (5 weeks)	**23,260**	**85,585**	**105,578**	**73,491**	**61,631**	**47,708**	**397,253**	.....	.....	**44,768**
July, 1940 (4 weeks)	43,985	66,470	90,257	55,365	35,984	55,791	347,852	.....	.....	38,142
August, 1939 (5 weeks)	13,445	104,525	38,811	57,338	59,163	37,940	311,222	.....	.....	14,042
Eight Months — 1940	137,032	505,912	471,653	379,674	376,322	264,128	.....	2,134,721	.....	157,752
Eight Months — 1939	106,044	675,015	306,965	389,700	371,193	206,998	.....	.....	2,055,915	79,689

Road program takes shape as state surveys proceed

New and unexpended money available

The defense program will require the improvement or construction of 3,112 miles of access roads into about 120 cantonments and military reservations at a cost of $202,000,000. Federal Works Administrator Carmody revealed this in commenting on the new authority granted him to enforce military priorities in approving state road programs under the highway authorization bill signed this week.

At the same time the administrator released the state allocations of federal aid money for fiscal 1942, which would ordinarily be made public in December. He intimated that the 1942 funds might be made available to the states, for obligation, earlier than usual in order to speed up vital defense road construction throughout the country.

Financing procedure

In addition to the new federal aid money just authorized and allocated, unexpended balances of federal road money amount to $197,000,000:—$121,000,000 for federal aid, $23,000,000 for secondary roads, and $53,000,000 for grade crossings. The new law permits the Public Roads Administration to require that this, as well as future money be devoted to defense projects.

The figures on access roads are the first results of a state-by-state survey of the 75,000 miles of militarily important roads in the nation. A report based on this study will be submitted to the President early next month. It will cover all the highway work necessitated by the defense program.

Of the access roads, 1,241 miles are located within military reservations and would be financed, in the main, from Army appropriations or WPA funds. The remaining 1,871 miles would mainly be financed through regular federal aid produce though the general question of paying for defense roads is still open.

Bridge survey

The as yet incomplete survey has already revealed that of the 16,000 rural bridges on the strategic highway system, 1,800 have less than an H-15 capacity—the strength desired by the Army. About 150 have vertical clearances of less than 12½ ft., while 1,700 have horizontal clearance of less than 18 ft. Of the road mileage, 5,500 miles is less than 18 ft. wide, while 14,000 miles is incapable of handling a 9,000 lb. wheel load and will have to be strengthened. Costs of doing this work have not yet been determined.

Washington Press—Photo Bureau

William Bowie dies, noted geodesist

William Bowie, known in geodetic and geological circles throughout the world for his investigation and practical proof of isostatic equilibrium of the earth's crust, died in Washington Aug. 28 after a short illness, at the age of 68. He had been Chief of the Division of Geodesy of the U. S. Coast and Geodetic Survey for more than a quarter century prior to his retirement four years ago.

Major Bowie's entire career was devoted to the work of the Coast and Geodetic Survey. A native of Maryland, he was educated at Trinity College and Lehigh University (CE 1895). After graduation he entered the Coast and Geodetic Survey and was engaged in geodetic work throughout the United States and possessions until his appointment as chief of the division in 1909. During the World War he became a major in the Corps of Engineers and served in the mapping division of the Chief of Engineers office.

He was widely recognized in this country and abroad for the many contributions in surveying and geodesy that sprang from his keen understanding and wide knowledge. His outstanding work was in the field of isostasy. Bowie's elaborate studies of gravity results, triangulation data and plumb-line deflections in the U. S. demonstrated the existence of crustal balance regardless of topography, and determined the depth at which the adjustment is substantially complete. Later deduction from earthquake wave records that the material of the earth's crust changes character a number of miles below the surface was in close agreement with Bowie's results.

After retirement Major Bowie continued his interest and participation in geodetic matters. A year ago he took over the editorship of *The Military Engineer*, continuing in this work until shortly before his death.

Many distinctions and decorations were conferred on Major Bowie. He was active in the work of many scientific and technical societies, including the American Society of Civil Engineers, for which he served as chairman of the surveying and mapping division for more than a decade. He had been president of the Philosophical Society of Washington, the International Geodetic Association, the International Union of Geodesy and Geophysics, the Society of American Military Engineers and other organizations, and chairman of the federal Board of Surveys and Maps. He was the first recipient of the William Bowie medal, founded by the American Geophysical Union to honor cooperative research in fundamental geophysics.

• • •

Senate votes U. S. control of water transport

A bill to bring inland and coastal water carriers under federal regulation similar to that now covering motor and rail transportation won final Senate approval Sept. 9 ending a legislative controversy of nearly two years' duration. The bill had its origin in the recommendations of a special committee appointed by the President in 1938 to make recommendations for remedying the railroad's financial situation.

Proponents of the legislation contended that it would eliminate "unfair" competition by waterways and provide equality of regulation for all types of transportation. Inland, coast-wise and intercoastal water carriers, except certain types not competitive with land transportation, would be brought under regulation by the Interstate Commerce Commission. Foreign commerce would be left under the Maritime Commission. The present requirement for reduced rates on government traffic over the so-called "land grant" railroads, except for military and naval traffic, are repealed under terms of the bill.

President Roosevelt is expected to sign the bill which will create a three-man board of investigation and research to be appointed by the President. The board would investigate the relative efficiency of each type of carrier for each kind of transportation and the extent to which each type has been subsidized by public funds.

• • •

Chicago underground men organize the ground hogs

The Ground Hogs, a society formed solely for social purposes, has been organized by a group of subway, sewer and foundation engineers and contractors in Chicago. Organization and development work are in the hands of a committee headed by George Salter, of the Chicago Department of Subways and Super Highways.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Pile Bearing

Sir: In the article on p. 172 in the Aug. 1 issue by Mr. Lidicker, on "Pile Bearing Increased by Close Driving", I think incorrect conclusions have been drawn. The results are exactly what could be expected.

Every piledriving contractor has found that if he has foundation piles to drive for a pier, he should start on one side of the pier and drive across the pier or drive the center rows first and then work out, driving the rows toward the sides of the pier; and that if he drives all the outside piles first, working toward the center, he will have hard driving on the center piles. This is due to the compacting of the earth and the fact that the earth displaced by the pile is obstructed greatly in flowing out of the way.

The piles in rows *D*, *E*, *F* and *G*, Fig. 1, p. 69, all have the same resistance to driving, and should have, as the material is confined on one side only.

The center piles Nos. 1 and 45 will have the greater carrying capacity. The engineer's problem is not (so much) the carrying capacity of any one pile as that of a group.

If sixteen piles, as an example, are driven on three-foot centers in square, they will not have sixteen times the supporting power of one pile driven individually.

The supporting power of a pile is due to two factors: friction on the sides and the support of the earth on which the pile rests.

The force due to friction is transmitted to adjacent earth and is spread over a large area at the point of the pile, this area depending upon the length of the pile and the character of the earth penetrated.

The perimeter of a group of sixteen piles driven on three-foot centers in a square is not equal to sixteen times the perimeter of one pile and the area at the point of the piles on which the group bears is not sixteen times the area on which one pile bears. Therefore, the supporting power of the group will not be sixteen times that of one individually driven pile, as proven by tests.

If the piles are driven on less than three-foot centers the perimeter and bearing area of the group will be less and the supporting power less.

E. H. CONNOR
Vice President and Consulting Engineer
Missouri Valley Bridge & Iron Co.

Engineering Council

Sir: I have read with interest your editorial on American Engineering Council which appeared in your issue of Aug. 15. My first contact with Council was in 1928 when I made an intensive study of its operations as member of a committee of the American Society of Civil Engineers, for the purpose of advising the board of direction on the desirability of joining Council; the result of a favorable report was the approval by a referendum to join Council. Since then I have had almost constant contact with Council as a representative of Am. Soc. C. E. and am fairly familiar with its operations.

It has been my observation that Council has consistently done those things and advocated those policies for which it was set up. As an organization it has looked after the interests of engineers at Washington, it has kept them advised of matters of interest, it has been an embassy for the engineers, but in a larger sense it has kept close touch with legislation and administrative action, advocating the welfare of the country wherein engineering knowledge and experience were able to advise without regard to self-seeking or material reward. In this regard we must acknowledge the idealism of Council, which in a larger and better sense points the way to the profession at large for a higher respect from the public as a professional group. It is believed this idealism has won the admiration of all of official Washington as there are constant calls upon its services which are nonpartisan and gratuitous and accepted as such.

We might take issue with the editor that Council's kite was tied to Herbert Hoover. As the first President of Council and as an eminent engineer it was expected of the profession that they would have at least a casual interest in the elevation of an engineer to the Presidency without regard to the political creed of the individual. But in so far as Council as an organization is concerned I doubt if it could be classified as kiting.

The relations of Council have ever been cordial with the American Association of Engineers, but they did not see their way clear to join, believing, I assume, that they could better work out their destiny alone. However, so far as the state societies are concerned, our contacts have been close, as seventeen state societies are members of Council and most of these state societies were members prior to the existence of the National Society of Professional Engineers. The entity of these societies is separate and distinct from the national society; they are such as the Illinois Society of Engineers and Surveyors. Six years ago we had four state societies as members and we now have seventeen. The local societies have increased from eleven to thirty.

That such an organization as Council is needed and merits the support of all engineering organizations is confirmed by the report of a joint committee of eminent engineers from the three Founder Societies and from Council, a total of twelve men who reported after months of deliberation as follows: "The committee is convinced that there is need for a strong national organization to be located in Washington to represent all engineers. The designation should continue to be American Engineering Council."

American Engineering Council feels that, besides giving coordinated expression to the engineer's viewpoint and responsibility on public questions, it must aid in bringing about a better appreciation on the part of the public of the importance and value of engineering services. Thus, American Engineering Council is concerned with the economic status of the engineer, the relation of the engineer in private practice to governmental and other agencies, the extension of civil service, and other matters which are definitely intended to further the welfare of the public and the enhancement of the engineering profession.

American Engineering Council appreciates the strength potential in

cooperation among engineers, particularly in matters pertaining to government, the welfare of the profession and service to the public. Accordingly, it is working for the unification of the engineering profession in viewpoint, thought and action. It hopes to bring about unity and solidarity in the engineering profession without, however, interfering with the technical fields or with the autonomy of its member engineering societies. It also expects to bring about concerted action on the part of engineers for public questions of national scope, and definite interest in a well-balanced social structure and in good government. By assuming leadership for the engineering profession in matters of joint interest to the various engineering groups, American Engineering Council serves the engineer and public.

ALONZO J. HAMMOND
President, American Engineering Council
Washington, D. C.

Aqueduct Maintenance

Sir: The story, in the issue of June 6, covering an interview with Mr. J. E. Phillips, maintenance engineer of the Los Angeles Aqueduct, especially interested me. I have been engaged for the past 25 years in both maintenance and construction of long, small, municipal pipelines in Western Colorado, where, because of the configuration of the country, nearly all the cities and towns get their domestic supplies from the high mountains and carry these supplies for considerable distances, through great differences in elevation.

Materials for these lines have been steel, cast iron and wood stave, but certain of the difficulties, while difierently manifested, have been traceable, as difficulties on the Los Angeles Aqueduct seem to be, to certain fundamentally unsound concepts as to location of long pipelines, and to lack of realism in the analysis of the hydraulic problems of such long lines.

Nearly all pipelines have been located in straight lines. In long pipelines reliable operation and effective, economical maintenance call for such variation of alignment as will result in dividing the distance to be covered into sections of somewhat uniform gradient. There is just as sound reason for this attention to working grades on pipelines as there is for the same attention on railroads or highways.

Standard texts on hydraulics do not take account of the fact that it is physically impossible to fill a pipeline completely with water; there will always be a variable and varying amount of dissolved, entrained or free air, and usually of all three forms of air, also flowing in any pipeline. Because of this fact it has been found to be necessary to devise such entrance structures as will reduce air volume to a minimum, but not to attempt to exclude that volume of air which will inevitably enter in some way or form into any pipeline. It is utter waste to buy pipe of a certain size, and then by unsound installation and improper detail design to condemn a greater or less part of the purchased capacity to carrying air.

Having set up the most efficient condition possible at the entrance to a pipeline the gradient of each section of pipe must be maintained relatively constant, with adequate provision for adjusting volume of air for each marked change in gradient. Neglect of proper handling of air will inevitably cause throttling in certain sections of a pipeline and free flow in other sections, and will manifest itself as leaky rotting staves in wood pipe, by reduced capacity in metal pipe and in some cases by phenomena like the "breathing" complained of on the Los Angeles Aqueduct.

After many years' experience the most successful pipeline I have constructed was one in which entrance structures were as nearly perfect hydraulically as possible, but immediately below the intake for each section of pipeline a free air vent was installed. At each change of pipe size, both sizes of pipe were freely air vented and the water was occasionally passed through small, buried concrete tanks located where grade line permitted, so arranged as to separate out as much of the intimately entrained and dissolved air as possible and to get rid of all free air. This line has been in service eleven years, has always carried the designed quantity of water, has no operating peculiarities, and the cost of maintenance on the untreated wood stave pipe has been less than $15 per mile for the whole period.

In venting air from or into pipelines it has been found from experience that only one form of vent is satisfactory—the full size T-opening into full size pipe, carried above hydraulic grade. This form of air vent does not seem to be open to the objections mentioned in the story that high velocity and differences in pipe size prevented proper venting of air.

It has also been found that where syphons are necessary they must be treated as individual structures and that their air control problems must be localized on the syphons themselves, and not allowed to lap over into stretches of pipe of uniform gradient.

F. C. MERRIELL
Chief Engineer
The Colorado River Water Conservation District

Engineering for Navy's Fee Contracts

Sir: In the description of the "Navy's Partnership Contract" in the issue of Engineering News-Record of Aug. 15, 1940, p. 62, it is stated that "the contractor is to make plans and specifications". This statement doubtless will give the impression that all engineering services are being furnished by the contractors. Actually, all plans and specifications were prepared either by the Bureau of Yards and Docks or by outside engineers and architects retained for the purpose, and the fee contractors have furnished no engineering services other than of a minor character required for scheduling and purchasing materials, detailing of form work, staking out buildings, etc. Your engineer readers will, I believe, be interested in this statement of policy.

B. MOREELL
Rear Admiral
Chief of the Bureau of Yards and Docks
U. S. Navy

The Navy contract provides that the work "shall conform to the following enumerated plans which will be furnished by the government to the contractors . . . and such further detailed plans in amplification thereof as may be furnished by the government from time to time during the progress of the work". It further provides that "the contractors shall furnish all plans and specifications supplementary to and in amplification of those enumerated . . . which may be determined by the contracting officer to be necessary . . ." As the above letter states, in the application of these clauses all plans and specifications were furnished the contractor.—EDITOR.

EDITORIALS

VOLUME 125 NUMBER 11

September 12, 1940

Now Is the Time

WATERWORKS UTILITIES bear an important responsibility in this period of industrial mobilization for defense. Reliable and adequate water service—a prime essential for processing requirements and fire protection—calls for immediate correction of deficiencies. A group of articles in this issue focusing attention on what a number of progressive communities are doing to increase the efficiency of their water service can aid in planning such correction.

Dam Supervision

FLASH FLOODS in the sandy, coastal plain of southwestern New Jersey on Sept. 1 caused heavy local damage through dam failures resulting from progressive failure of small upstream dams. Fortunately, the damage was not as great as certain reports would have it, and the lesson learned from this experience should serve as some compensation for the cost. Once again has been demonstrated the necessity for careful state regulation and supervision of small dams, particularly those which are built for recreational projects. Too often private or local interests balk at meeting construction recommendations or maintenance requirements, arguing that small dams or ponds do not endanger the regions downstream. These arguments have little weight in the light of what happened in New Jersey.

News Worth Noting

TRAFFIC GROWTH POTENTIALITIES are emphasized by Golden Gate Bridge operation, which last year was in the black after several years of initial deficit. Though Golden Gate is unlikely ever to be as profitable as its neighbor, the Bay bridge, its present earnings confute the pessimism of those who predicted that it would be a losing venture. By this time, therefore, both the big San Francisco bridges have reached the point of paying their way, and the traffic in and out of the peninsula is justifying an investment of well above a hundred million dollars. That the period of early losses was short proves that the saving of time and trouble made possible by the replacement of ferries by bridges is of real importance to community life. It also shows that, while some traffic prognostications have been over-optimistic, more often the truth of gate receipts surpasses the fiction of the forecast.

Providing for Traffic

ON THE OPPOSITE COAST, beginning of work on the Battery vehicle tunnel further emphasizes the cash value of new thoroughfare traffic links on main arteries, for this high-cost project in conjunction with its companion links in New York's belt highway is expected to pay for itself in relatively few years from moderate toll charges. The expectation is not likely to be disappointed; witness the fact that in barely two years the six-lane West Side Highway, boldest feature of the belt system, has drawn so much traffic as to present a picture of almost hopeless congestion during peak hours. Experiences of this kind contradict the view sometimes expressed that traffic facilities have been overdone. They show that need exists for many more roads, bridges and tunnels. Providing for traffic in the modern manner is not cheap, however, as the estimates for the Battery tunnel indicate. It is therefore not to be expected that the mounting investments for improved traffic facilities can be met from tax revenues.

Small Structures

ALTHOUGH such monumental works as Boulder Dam and the Panama Canal emphasize the debt that the profession owes engineers in the federal service, they do not begin to suggest how widespread is the influence of the engineering work of these public servants. Particularly is this true of the men in bureaus that build relatively small structures. The U. S. Forest Service and the National Park Service are two of these bureaus. In the matter of recognition the Park Service fares somewhat better than the Forest Service by virtue of frequent spectacular bridge or tunnel jobs in the high mountain parks. But the Forest Service's achievements are quite as significant. During the past decade it has been particularly active in small dam building, a field where sound engineering principles are too often conspicuous by their absence. In adhering to as high standards for small dams as for large ones the Forest Service is following a practice that deserves wide emulation. And the profession could

justifiably pay tribute to it as an important force in raising standards for small structures.

Innovation

AN ABLE ENGINEER who himself overthrew many precedents used to say that the way a thing has always been done is quite likely to be found the wrong way. Though extreme, the sententious remark points directly to the clay feet of precedent and tradition, and suggests the wide open opportunity for bettering practice by innovation. This week's technical reports tell of two noteworthy cases of innovation, the one-leg bents used under the channel span of the Housatonic River bridge and the cavity-wall enclosure of a Montclair building. Both expedients were the response to specific requirements. The novel bridge bents, paralleling the idea embodied in the umbrella piers of the Scarsdale bridge on the Bronx River Parkway, were devised because of the necessity of reducing channel encroachment; the hollow brickwork was resorted to as assurance against the leaking-wall trouble so common in recent building experience. Both innovations have many possibilities of useful application elsewhere, and where their overall costs are favorable, they warrant consideration as types of approved practice.

Higher Pump Efficiencies

TO PUSH PUMP EFFICIENCY up to nearly 92 per cent as was done in the case of some of the units for the Colorado River Aqueduct is a remarkable accomplishment. The results justify the careful designing, the meticulous model testing and the precise manufacturing that were each a part of the program.

They also raise question as to whether we have not about reached the ultimate in pump efficiencies. Usually prototype efficiency is greater than the efficiency of the model, but the reverse was true in this instance. Perhaps the models were definitely superior to any heretofore used, but it is also possible that the pumps were so large that it was difficult to make the castings conform exactly.

The aqueduct pumps set a record for efficiency that was not thought possible for such units several years ago. Considering the care with which they were designed and tested, one apparently has to look to more precise manufacturing for any further increase in pump efficiencies. Since the manufacturers in this case had the incentive of a substantial bonus and did succeed in achieving record efficiencies, the doubt will not down that further increases are improbable. Still, ambitions have a way of brushing doubts aside. That is why the aqueduct pumps have an efficiency five points or so above the conventional figure.

Watering the Desert

ARIZONA, home of many remarkable water schemes in the past, again comes to the front with a bold project, a 190-mi. canal scheme with 1,000 ft. of pump lift on the way. Roughly comparable to the great Colorado Aqueduct in flow volume, lift and length, but estimated to cost only a small fraction as much, it is interesting primarily because it illustrates anew the urgency of the Western demand for water to make the desert inhabitable.

Water can and does transform the desert into farms and towns. As a byproduct of its crops it develops new areas and centers of human life, and this in the last analysis constitutes its chief value. How great a demand exists for new settlement areas may be judged from the numbers of migrants from the Great Plains who are drifting around in the Far West, estimated by the Northern Great Plains Committee at tens of thousands. New irrigated lands would offer them opportunity to found a stable and successful existence. Every new supply of water should therefore be made the means of developing fresh farming areas.

But while the ultimate value of irrigation development lies in creating new living opportunities, this value is only a byproduct of profitable production. Under present conditions agricultural production often is a losing venture, if credence can be given to complaints from many irrigated areas. Since an irrigation development is an obvious failure if its productive value does not carry the cost of the improvement, and since idle land on which to resettle migrants is available in regions better favored by rainfall, the dollar test of productive power still retains its validity.

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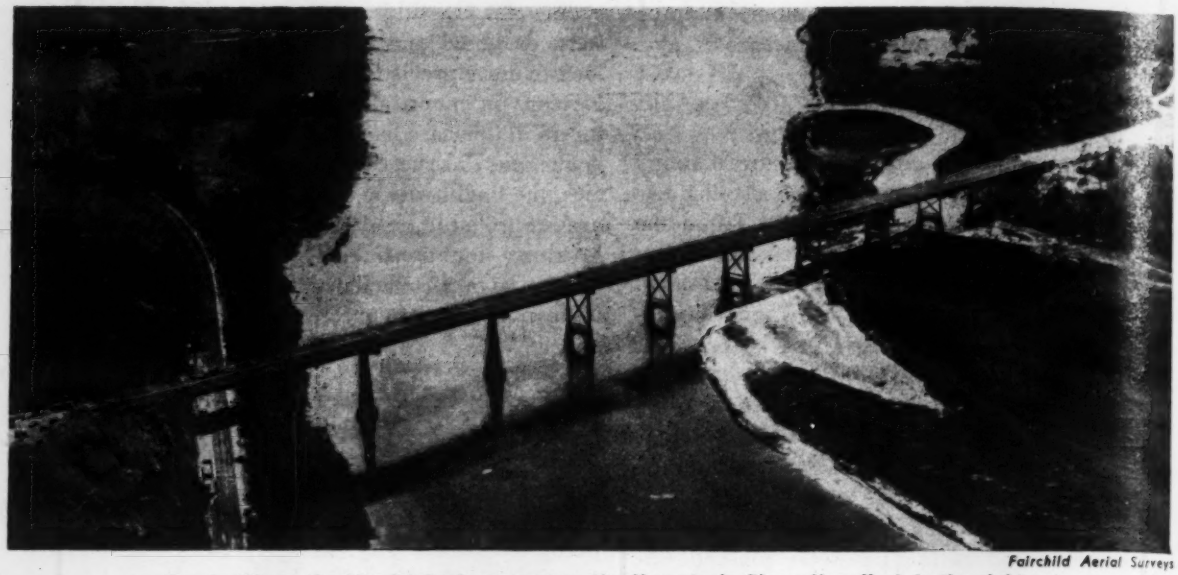

Fairchild Aerial Surveys

Fig. 1. Where the Merritt Parkway crosses the Housatonic River. New York is the right.

One-Leg Bents Support Steel Grid Deck

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***Contents in Brief**—An unusual steel girder viaduct has been built to carry Connecticut's Merritt Parkway over the Housatonic River to a connection with the Wilbur Cross Parkway, which will extend this nationally famous toll road to Hartford. To shorten the span required over a channel that is skewed with the bridge centerline, one-leg bents or towers supported on single cylindrical piers were utilized. The bridge is also notable for the largest installation to date of the open steel grid type of floor—two 26-ft. roadways 1,824 ft. long. Erection was by derrick boat and deck traveler.*

TWO RATHER UNUSUAL FEATURES characterize the new bridge over the Housatonic River between Stratford and Milford, Conn., which was opened to traffic last week. Most unusual is the use of canopy type towers styled "one-leg bents" at two of the piers, but also of note is the open grid steel deck, used here for the first time for the entire length of a long bridge, 1,824 ft. being the distance between abutments. Of deck plate girder type with spans varying from 128 to 224 ft., the bridge will be the connecting link between the Merritt Parkway, which extends westward to the New York state line, and the Wilbur Cross Parkway, which is projected to be extended eastward across the state to the Massachusetts state line.

Referring to Fig. 1, there are 12 spans starting from the west abutment at the right. The plate girder type was adopted because it resulted in an economical design and is simple in appearance. Making all girders of uniform depth throughout the entire length of the viaduct contributed to this simplicity. Spans 1, 2 and 3, each 128 ft. long, are a continuous unit, resting on four supports. Spans 4, 5, 6 and 7, each 160 ft. long, form a continuous unit on five supports. Spans 8, 9, and 10 comprise a cantilever structure with a main span of 224 ft. and anchor arms of 160 ft.; the 224-ft. channel span is made up of two cantilever arms of 32 ft. each and a suspended span of 160 ft. Spans 11 and 12, at the east end, each 128 ft. long, form a continuous unit on three supports. It will be noted that the various span lengths are multiples of 32-ft. panels.

Fixed shoes are used at the abutments for the continuous units at either end. The four-span continuous unit is fixed at pier 5, while the cantilever unit is fixed at piers 8 and 9, where the one-leg bents are used. At all other piers, the two-leg conventional bents used are of rocker type, hinged top and bottom.

The roadway provides for four lanes and has a permanent central island separating the east and westbound traffic. Advantage was taken of the central island to use three lines of girders, thereby utilizing the top flanges of the center line of girders as the island.

The one-leg bents

The reason for the use of the one-leg bents at piers 8 and 9 rests in the location of the navigation chan-

Fig. 2. One-leg bents on circular piers carry the three lines of main girders. The open grid steel deck is in place on the right half of the roadway.

George M. Mathieu photo

nel which is near the east bank and crossed by the viaduct at an angle of about 58 deg. Required navigation clearance was 150 ft. normal to the channel which amounted to about 177 ft. along the centerline of the viaduct. Using the ordinary type of bent and a normal rectangular pier, it would have been necessary, on account of the width of the viaduct, to make the channel span about 250 ft. long. While girder spans exceeding that length are in existence, it was felt desirable to use the shortest span possible. The solution was to use a single column tower of the canopy type, resting on a cylindrical pier so located that the channel lines would be tangent to the pier. The resulting span, as stated, is only 224 ft. long.

Canopy tower design

In the canopy tower the floorbeam at the top consists of two cantilever arms of equal lengths with one point of support at the top of the column. The center girder of the roadway rests directly over the column, and its reaction is carried to the pier in direct compression through the column. However, the reactions of the outside girders, located 29½ ft. from the centerline at the end of the cantilever arms, introduce a considerable bending moment in the column under a condition of maximum live load on one roadway and very little live load on the other. Since this condition is one that will occur on numerous occasions, it was a prominent factor in the design. In addition to the unbalanced live loads, the wind and other lateral forces on the spans will produce an overturning moment at the top of the column. To secure the tower to the pier, several anchor bolts are provided, some 5 in. and some 4 in. in diameter; the latter, placed near the centerline of the bridge, are used primarily to prevent overturning in the direction of traffic, due to the action of the longitudinal forces.

Pier design

The maximum eccentric loading occurs when the wind is blowing and there is full live load on the leeward lanes with no live load on the windward lanes. These same unbalanced

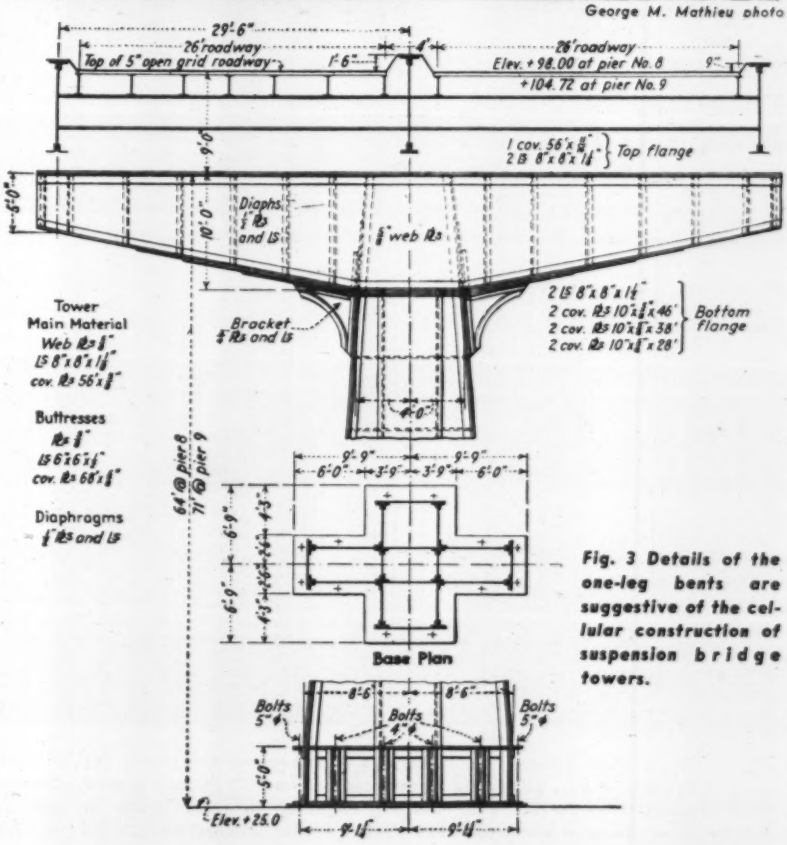
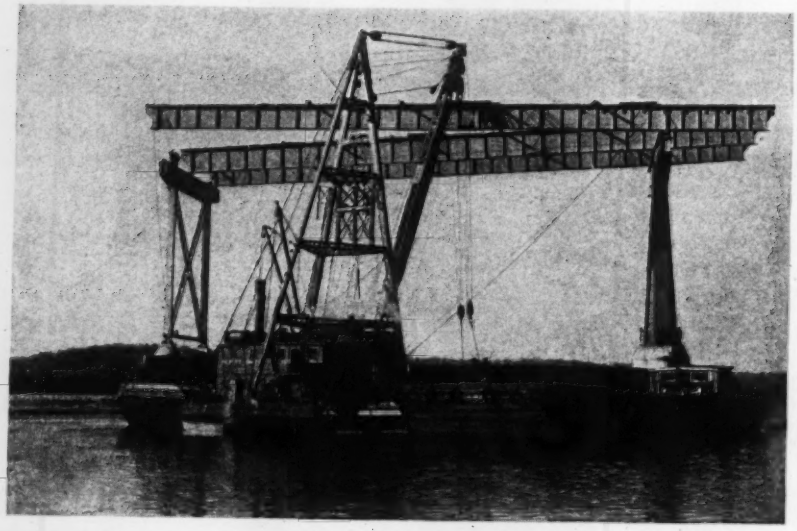
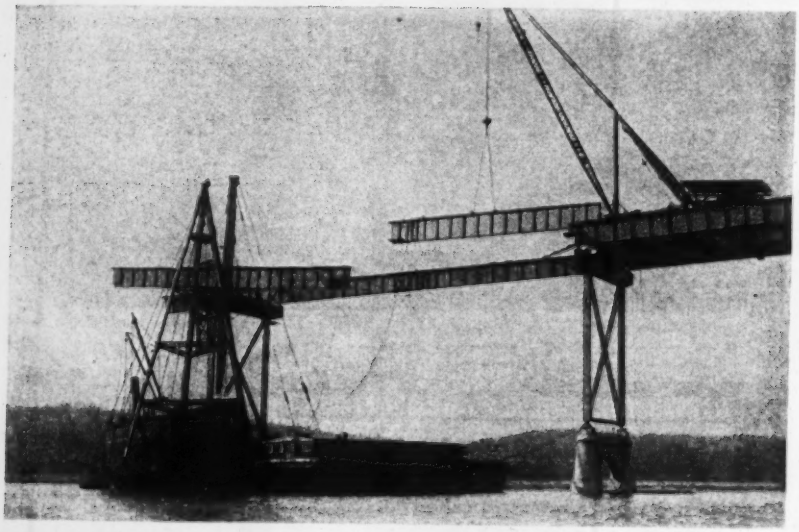
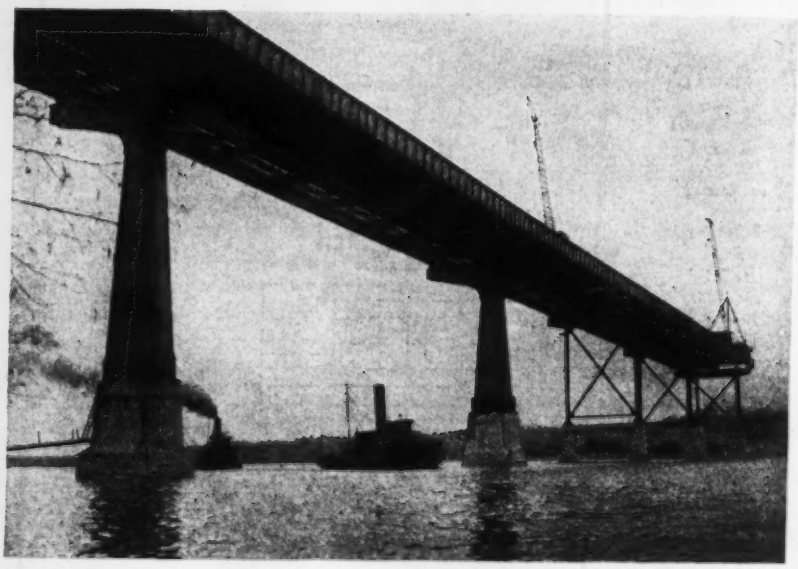


Fig. 3 Details of the one-leg bents are suggestive of the cellular construction of suspension bridge towers.







George M. Mathieu photo

Fig. 4. Both a deck traveler and a derrick boat erected the steel. Top, derrick boat lifting the 192-ft. girders in span 8 that extend 32 ft. into span 9. Center, deck traveler and derrick boat working together to erect girder of span 7. Bottom, last steps of erection when deck traveler worked alone.

live loads and lateral forces also act on the cylindrical piers, which were designed to withstand the overturning moments resulting therefrom as well as the overturning moments produced by the effect of ice, current and wind forces acting on the piers themselves.

Open-grid floor

The second novel feature of this bridge is the open steel grating used for the floor. The Connecticut highway department has used open grating floors on three smaller bridges since 1937 with good results and with no complaints except from the drivers of an occasional horse-drawn vehicle. A distinct advantage of the open grid floor over solid floors is the elimination of the snow removal expense, but most important is its light weight, 20 lb. per sq.ft. as opposed to 54 lb. for the 3½-in. concrete filled steel grid decks and to 100 lb. per sq.ft. for the ordinary 8-in. reinforced concrete slab. With two lanes, each 26 ft. wide, there is a saving of about 1,800 lb. per lin.ft. over the 54-lb. deck and a saving of nearly 4,000 lb. per ft. over the 100-lb. deck. This saving in dead load resulted in an appreciable money saving on the Housatonic River bridge.

Construction procedure

Foundation work, described in *Engineering News-Record*, July 27, 1939, p. 114, was simple and without particular incident. The east abutment and Piers 8 and 9 are carried to rock, maximum depth about 45 ft., while the remainder of the piers are founded on steel H-piles. A pneumatic caisson was used for pier 8 but pier 9 was put down in an open cofferdam.

Because of the location of railroad tracks under span 11 on the east bank of the river, the steel erector elected to start work at this end of the bridge where steel could be brought in on a siding. Spans 11 and 12 and their steel bent supports thus were erected first, using a locomotive crane in combination with a tractor crane. A temporary wooden bent was used in span 12 some 90 ft. west of the abutment, which permitted the girders of this span to be erected in two sections; the girders of the span over the tracks were, however, lifted in one piece.

With these two spans in place a starting platform was available for a deck traveler, which was erected over

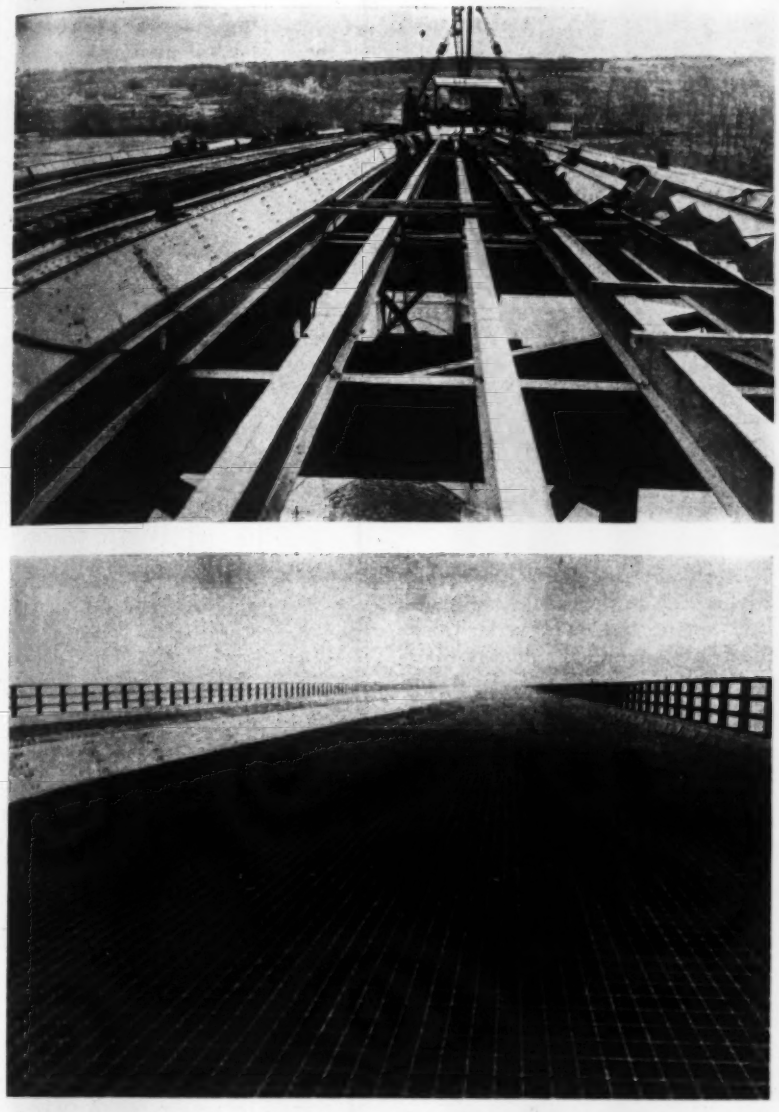


Fig. 5. Deck of Housatonic River Bridge consists of two 26-ft. roadways floored with open steel grid. Center girder provides the separating island.

the north half of the roadway to ride on the center and north lines of girders. A stiffleg derrick, erected on the south side of span 11, lifted steel from railroad cars to the deck to serve this traveler, which erected the steel as it moved westward, assisted on the river spans by a derrick boat. Although most of the steel came in by railroad, that for bents, 6, 7, 8 and 9 and the girders for spans 7, 8, 9 and 10 was delivered by barge.

Erection of these river spans was the most difficult part of the job. First operation was the placing of the one-leg bents at piers 8 and 9 by the derrick boat. Then with the deck traveler lifting the east section and the derrick boat the west section of the girders of span 10, simultaneously, this span was assembled; the west section of the girders of this span contained the 32-ft. cantilevers that extended out into the channel span.

Operations were now shifted to the west end of the channel span where the derrick boat, unaided, raised bent 7 and the three girders of span 8 which, including the 32-ft. cantilevers into the channel span, were 192 ft. long. These girders, which came to the job in two sections, 70 and 122 ft. long, were connected on the barge and lifted as one piece weighing 76 tons. These were the heaviest erection pieces, although the largest girder on the bridge is the 160-ft. center girder of the suspended section of the channel span, which is 9 ft. deep over the cover plates and weighed 70 tons. These suspended section girders were also placed by the derrick boat.

After the traveler had filled in the floor system and bracing of the channel span and anchor span it was at bent 7 ready to aid in the erection of the girders of span 7. The derrick boat set bent 6 and then, as it had done for span 10, raised the west half of the girders simultaneously with the lifting of the east half by the deck traveler. This operation completed the use of the derrick boat, for the deck traveler, standing on the cantilever of the span 7 girders that extended out into span 6, was able to place the bent at pier 5. The remainder of the steel to the west abutment was erected by the traveler following this same "reach-out" procedure.

The bridge, financed with the aid of a 45-per-cent PWA grant, was designed by the writer and B. D. Freedman in the office of L. G. Sumner, engineer of bridges and structures of the state highway department. A. I. Savin Construction Co., Hartford, built the entire substructure (contract price, about $410,000) with the exception of the pneumatic caisson at pier 8 which was sublet to Senior and Palmer, New York City. American Bridge Co. handled the superstructure contract, which was let for about $520,000. For the state, construction was under the supervision of Leo Conaty, resident engineer, and Howard Ives, assistant resident engineer, both of the office of A. W. Bushell, director of engineering and construction. The entire project is under the direction of William J. Cox, state highway commissioner, and E. C. Weldon, deputy highway commissioner.

With the bridge opened to traffic, the second toll station on the parkway system is in operation. A toll of 10c. on the completed part of the Merritt Parkway, which has been collected at Greenwich since June 21, 1939, has provided funds which will be used toward defraying the cost of extending the Wilbur Cross Parkway from the Housatonic River to the vicinity of Hartford. This toll station has yielded about $490,000 the first year and it is anticipated that about $300,000 will be collected at the new station at Milford. All revenues will be used exclusively to pay for the cost of collecting tolls, to pay interest on the bonds and to provide for bond amortization. It is expected that all bonds will be amortized and tolls removed from the parkway in about 15 years.

Introducing the Cavity Brick Wall

***Contents in Brief**—Metal-tied brick walls of two 4-in. withes were adopted for a large Montclair, N. J., apartment house as leakproof and insulating inclosure, on the strength of long successful use in England. Full flashing of outer withe and cavity protects inner withe from percolation.*

HOLLOW WALL CONSTRUCTION of brick was adopted for the inclosing walls of the Rockliffe apartment house now being built in Montclair as a means of assuring high heat insulation and absence of wall leakage. This form of wall has been extensively used in England during several decades, under the name of "cavity wall", but is new in American practice. English experience is said to show that it is proof against the common evil of wall leakage. It also is lighter, cheaper and higher in insulating value than a solid brick wall of equal thickness.

Rockliffe Apartments is a seven-story building of fireproof construction, with reinforced-concrete frame and floors, brick walls and block partitions, being built on the site of the former Hotel Montclair at Claremont Ave. and Crestmont Road. The wall construction consists of 10-in. walls carried on the concrete spandrel beams of the frame.

The elements of the wall

As sketched in Fig. 4, the wall consists of two $3\frac{3}{4}$ in. withes spaced $2\frac{1}{4}$ in. in the clear and tied at every sixth course by double $\frac{1}{4}$-in. steel ties spaced about 20 in. apart. The inner withe rests on the floor slab, the outer withe on a shelf angle bolted to the spandrel beam, with full flashing of asphalted felt carried from the bed joint of the inner withe out over the edge of the floor slab, down along the face of the spandrel beam and over the outstanding leg of the shelf angle. Copper flashing is used at the junction of roofing and parapet wall and under the coping slabs of the parapet, the holding-down bolts of the coping being soldered to the copper where they pass through it.

Alongside door frames the brickwork is solid for one brick width or thickness. This supplemented by calking prevents entrance of moisture into the wall interior at the jambs. Window sills are slate slabs. At columns the outer withe is anchored to the frame by T-shaped metal anchors similar to those used as wall ties, engaging dovetail steel channels set in the column face.

Light colored Hudson River brick with belt courses of darker red Hudson River brick projecting $\frac{3}{8}$ in. every sixth or seventh course are used for the outer withe, local brick for the inner withe. Mortar is made of masonry cement. Laying up is done from outside scaffolds, starting with the two withes even at a metal tie course and carrying up the outer withe to the next tie course, then similarly carrying up the inner withe. To keep mortar from dropping into the interior or "cavity" of the wall, a 2-in. strip of wood is laid on the metal ties to catch droppings and pulled up by wires attached at the ends before the next course of ties is placed. The joints of the outer face are tooled concave as soon as possible after the bricklaying, while the joints on the inner face are cut flush and left as rough as possible to bond waterproofing or plaster.

Originally the construction plan contemplated plastering the inside face of the wall direct without waterproofing, relying on the absence of wall moisture assured by the construction. However, the insurance company that provided the mortgage loan felt that in the absence of comparable precedent to demonstrate the waterproof character of the wall it would be prudent to coat the walls with a waterproofing plaster base.

Introduction of this cavity wall construction in American practice is due to the efforts of J. H. Hansen, executive secretary of the New York Brick Manufacturers Association, following extended study of the leaking wall problem and recognition of the practical difficulty of overcoming leakage with certainty in normal masonry wall construction. This led Mr. Hansen to study the extended use of hollow walls of different types in English building practice, and finally to propose the metal-tied hollow wall or "cavity" wall for general use in this

Samuel H. Gottscho photos

Fig. 1. Steel ties in cavity wall as used at Rockliffe Apartments. Ties are spaced about 20 in. apart.

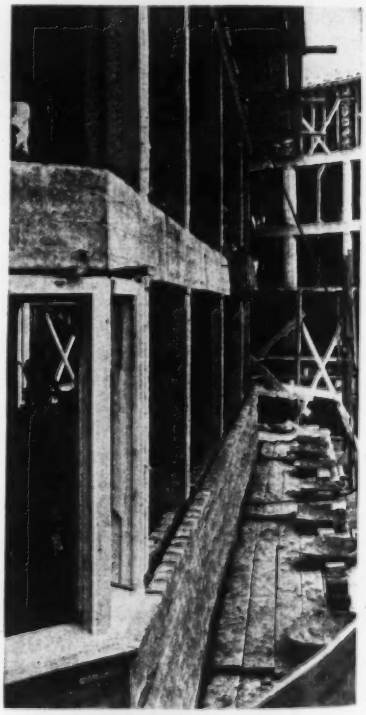


Fig. 2. Cavity wall construction inclosures the concrete frame and provides a continuous airspace for insulation and drainage.

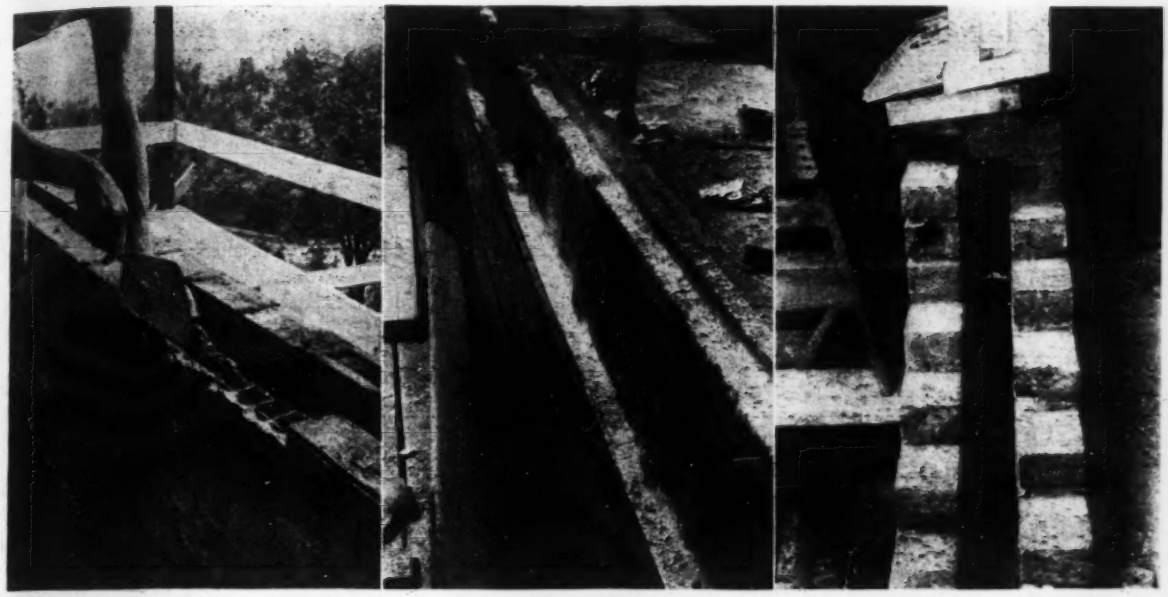


Fig. 3. Wall construction at Rockliffe Apartments. (Left) Laying up the cavity wall is much like ordinary bricklaying. (Center) Spandrel waterproofing is laid over second course of inner withe. (Right) Window stool rests on slate sill.

country. On presenting his proposal to the architects and contractors of the Rockliffe Apartments, he found ready appreciation of the advantages of this construction particularly by R. M. Catts, head of the contracting firm. After some difficulty in convincing leading authorities of its advantages, the cavity wall was adopted.

Standard in England

Hollow walls are a standard form of brick wall construction in England. Sometimes they are laid with solid header courses every sixth or seventh course of brick, sometimes with intermittent headers (header alternating with two stretchers in every fourth course, intervening courses being all stretchers), and sometimes with wire or flat steel ties (one tie for about 2 sq.ft. of wall). British authorities feel, however, that any brick header construction may cause leakage to the inside of the wall, for moisture penetrating the outer withe can bridge across on the headers and leak through the inner withe. Metal ties bent down in shallow U-form between the withes, to form a drip for any water attempting to pass across, overcome this difficulty, and such ties have therefore been used largely in hollow wall construction in England, both in housing and in larger structures such as warehouses, factories and hospitals.

For the Rockliffe Apartment job, the original proposal was to use Z-shaped ties of ¼-in. steel. Fear that the lack of symmetry of these ties might cause premature loosening led the loaning authorities to call for double ties welded together to form an I-shaped symmetrical connector, as shown in Fig. 4. While this additional requirement and that of waterproofing the inner face of the wall reduced the economy of the construction, its other advantages were retained.

The Rockliffe Apartments are being built by R. M. C. Construction Co. for Winston Paul, owner. Sugarman & Berger, New York, are the architects. Industrial Engineering Co. is subcontractor for the concrete work.

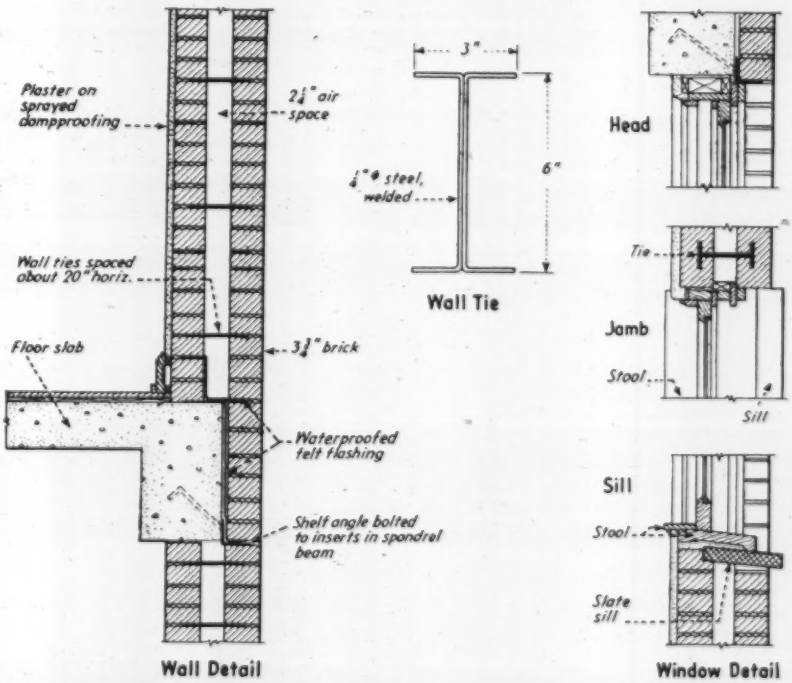


Fig. 4. Panels of cavity-wall brickwork are supported by spandrel beams and flashed to discharge seepage and condensation outward.

Traveler Speeds Arch Viaduct Forms

K. A. Sheppard
Assistant Superintendent
North-Eastern Construction Co., New York City

***Contents in Brief**—Problems of concrete arch construction on steep grades and sharp curves was solved by use of travelers to support the forms and provide a work platform for erection and stripping on a recently completed link in the approach system of the George Washington Bridge at New York City. The load of the deck concrete was carried directly to the footing by the vertical timber supports of the heavy traveler frame.*

ANOTHER LINK was added to the express highways of New York by the recently completed connection between the Harlem River Speedway and the George Washington Bridge by utilizing a tunnel constructed under 178th St. in 1931, which until now had no access to existing trafficways. The new section is a series of reinforced concrete arches winding along the hillside in Highbridge Park in a succession of curves, a type of construction that offered unusual complications in form building. A required "board mark texture" for the concrete, to harmonize with the rustic nature of Highbridge Park, presented another complication. Rough sawn lumber was used as forms and placed to leave projecting fins — horizontal on piers, parallel to road grade on the faces of the spandrel walls, and placed radially on the voussoir faces of the arches.

Construction

Piers are founded on ledge rock reached by a general shovel excavation over the site followed by clamming from sheeted holes at each pier location. Piers are generally 4 ft. by 8 ft. with footings only slightly oversize. Rock is benched or keyed to prevent slippage on the slope.

Shaft forms were made up in panels of lumber especially milled to leave the projecting fin, and were set by crane. Placing procedure required filling an entire 15-ft. lift in half an hour, necessitating forms designed for full liquid pressure. I-beam walers, lag-screwed to 4x4-in. studs, and bolted at the mitered ends, were used successfully, permitting quick and easy erection and stripping. Roughness of the face prevented lifting as an assembled unit. No interior ties were used except on a few irregular piers, the entire load being taken by bolts through clip angles welded along the mitered ends of the wales.

Wide World photo

Fig. 1. Approach to George Washington Bridge from Harlem River Speedway recently opened in New York City.

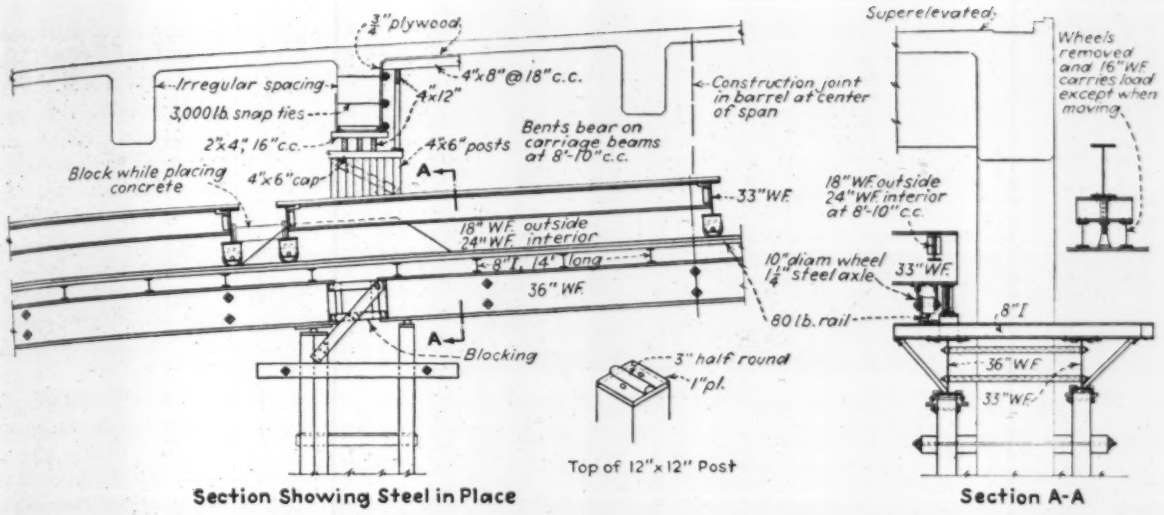


Fig. 2. Section of traveler for 100-ft. monolithic pour extending across one full arch and to the center of each adjacent arch. Traveler is decked solid for a work platform as forms must be entirely assembled for each use.

Designed primarily to support the falsework carrying the deck forms and concrete, 12x12 vertical timbers were erected and yoke tied around each pier shaft and utilized in bracing the haunch forms. These forms were placed in two side and two end panels with small steel beams used as walers; here 1¼ in. interior ties supplemented the bolted miter ends.

Traveling carrier

Only a few feet of the half-mile of arch-supported structure is on a tangent, and curves are of varying radii. Controlling grade is 8 per cent with superelevation on about a 6 per cent slope. The superstructure design is two-ring construction with transverse beams. Arches are 4 ft. thick with 3-ft.-wide beams 5 ft. deep spanning as much as 49 feet following the radial lines of the curves. The slab varies from 11 to 13 in. in depth. The deck is from 20 to 80 ft. above a sloping, rocky hillside, making forming and moving of forms unusually difficult. To facilitate this work travelers were designed so that the forms could be erected, supported, stripped and cleaned, then moved to the next pour without lowering any of the material to the ground.

One or two 12x12-in. timbers, depending on the load, carried the weight of forms and concrete to the footing. Timbers 20 ft. long were used, spliced by a square sleeve of ¼-in. steel plate formed to fit tightly over the ends of abutting timbers with four punched holes for nailing. A small quantity of grout poured in the sleeve after placement over the lower timber, prior to setting the upper timber, assured even bearing. The bottom of the lower timbers hugged the pier and were battered away from it on both sides to allow clearance for forms and travelers. Long bolts 1¼ in. and 1½ in. in diameter secured 10x14-in. timber yokes, the top timbers being lengthened to carry a working scaffold. Heavy steel plates, with rockers of half round shafting, welded on, capped the timbers and carried the wide flange beams spanning between adjacent piers as shown in Fig. 2.

The inner, 36-in. beam carried most of the load; the outer, a 33-in. lighter section beam, served to carry part of the spandrel arch, to stabilize the long span of the main member, and to simplify the rail support for the traveler. This support consisted of 8-in. transverse I's placed at about 6-ft. centers and clipped to the heavy girders.

Design placed contraction joints about 100 ft. apart, at the center of every second span, thus making one complete and two half arches in a monolith. Due to the sharp (95-ft. radius at one place) and reversed curvature of the structure, travelers were built in 29-ft. 6-in. detached sections for moving, and three were used together, with rigid blocking between, to carry the 100-ft. concrete section. Four sets of travelers were used for the different widths required for single to four-lane roadways. As all were similar in construction only the widest one, carrying the four-lane roadway with a 49-ft. clear span inside the arch spandrels, is described. Here a single section consisted of a frame composed of two transverse 33-in. 220-lb. beams 29 ft. 6 in. apart supported at each corner on 10-in.-dia. single-flanged wheels and separated by longitudinal 24-in. 74-lb. beams at 8 ft. 10 in. c.c.; outside longitudinal beams were 18 in. 55 lb. This framing was covered with 2-in. planking to make a work platform.

The traveler was supported on the rails only when being moved. When in position for forming the section was jacked up, the wheels removed, and short pieces of heavy structural sections placed to carry the load directly to the girder beams. Forms were then built up on the traveler, the steel framing being designed to take the entire load of forms and concrete.

Stringers were bolted to the 8-in. transverse I's to carry the arch forms. These forms were made in segments and were not typical. For the soffit, single forms specially milled to give the projecting fins were used while, for the face of the arch, double forms were required to give the desired rough surface. Beam forms of studded plywood panels on 4 by 12-in. stringers supported by bents made up of 4x6-in. posts, handled as a unit, framed into the spandrel arch forms. These posts were spaced at 8-ft. 10-in. centers to place them over the longitudinal beams. The bents also supported another stringer on each side of the beam.

Port of N. Y. Authority photos

Fig. 3. Assembling traveler for reuse on typical section after passing irregular intersection. Longitudinal beams, one shown being placed, are spaced 8 ft. 10 in.

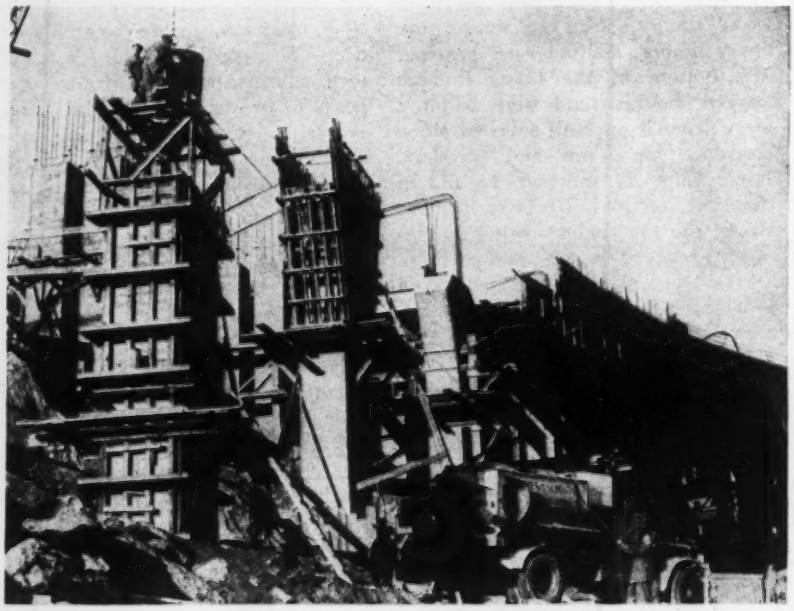


Fig. 4. Column forms with I-beam wales, eliminating the need for interior ties.

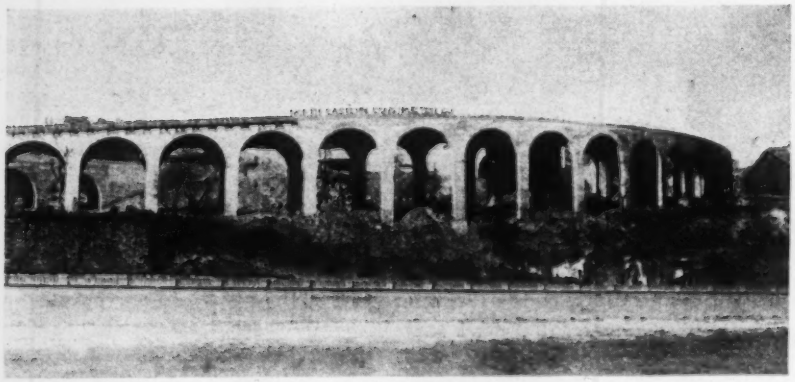


Fig. 5. Roman arches of rough texture concrete characterize viaduct design.

These stringers carried 4x8-in. spreaders at about 18-in. centers on which rested the plywood panels of the deck slab. Some cutting of deck panels was required for each use due to radial variation of the beams.

Anticipated deflection of the beams, shortening of the vertical timbers, and crushing of lumber under load were compensated by accurate wedging of individual sections to a position which would give correct alignment to the finished structure. Five-foot depth of cross-beams and varying shape due to curvature precluded moving the forms as an assembled unit. The beam bottoms and some panels were kept together, but the rest of the form was taken apart and carried on the traveler for reassembly in the new position.

Concrete for arch and deck was distributed by buggy, either directly from ready-mix trucks or from a hopper fed by a 1-yd. bucket hoisted by crawler crane. Maximum lift was approximately 80 ft. Pours varied from 250 to 525 yd.; maximum rate of pour was about 95 yd. per hour. All concrete was internally vibrated, and designed for a strength of 4000 lb. at 28 days except in footings, where 3000-lb. concrete was used.

A section of the new road carries traffic on a roadway from the Harlem River Speedway to a Y junction, one branch leading to the surface at Amsterdam Ave. and 179th St., the other leading into the tunnel to provide the only crossing of Manhattan not restricted by lights or cross traffic. Another section carries traffic from the high level surface streets to the tunnel, with a branch to the lower level. City-bound traffic from the bridge and tunnel has the option of reaching Amsterdam Ave. at 175th St. or going down the new structure to the Harlem River Speedway.

Personnel

Design and supervision of construction were handled by the Port of New York Authority, J. C. Evans, chief engineer; Ralph Smillie, chief engineer of design; Col. C. S. Gleim, construction engineer; R. F. Wheadon, resident engineer; and Aymar Embury II, architect for the project. The construction contract, amounting to about $1,000,000, was executed by North-Eastern Construction Co. under J. G. Rae, general superintendent and W. F. Conlin, superintendent at the site.

A "Pocket" Hydraulics Laboratory

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***Contents in Brief**—Compactness and flexibility distinguish the new hydraulics laboratory at Washington University. Pumping equipment, consisting of two small centrifugal units, has been ingeniously connected with pipes, tanks and multi-port cone valves to secure many variations of flow conditions. One of the special features of the laboratory is the friction pipe rack and measuring devices.*

LIMITED FUNDS AND SPACE were no detriment in constructing a fully equipped hydraulics laboratory at Washington University in St. Louis. To house the equipment a small wing of an existing building was available, and into this were fitted all the essentials for routine demonstrations and for the conduct of model studies. Because the plant is small, flexible and complete, it might be properly called a "pocket" hydraulics laboratory.

The ground floor of the laboratory is 60 by 25 ft., and a clear height of 25 ft. is available for half of the floor area. A storage reservoir with a capacity of 10,000 gal. was built in a sub-basement of the building and the water is recirculated. Certain economies resulted from this, but the real reason for this arrangement was to provide positive flow control. Plenty of outlets were arranged so that water used in any experiment or model study might easily be drained back into the reservoir. These drains are built up slightly so that water from the floor will flow into the sewer.

For circulating the water a 2-in. and a 5-in. centrifugal pump are used. These pumps, driven by variable-speed motors, are provided with different size impellers, which can easily be changed. The pumps are a permanent loan from the Charles S. Lewis Pump Co., and that concern reserves the right to replace them with current models at any time.

To facilitate pump testing, the chassis on which the pumps and motors are mounted are designed so that the motors can be cradled and both the pumps and the motors easily changed.

Pumps can be operated individually, and the flow can be switched so that two experiments may be run simultaneously during laboratory demonstrations. When larger quantities of water are required the flow can be combined through a pressure tank or through a 45-deg. reducing (really expanding) wye-lateral. With this arrangement a discharge of nearly 2.5 cfs is obtained.

Multi-port cone valves

In the larger lines cone valves are used entirely. For that reason the 5-in. pump uses a 6-in. line, and the 2-in. pump uses a 3-in. line. This tends to reduce losses. Three-way multi-port cone valves are used, and in a tee-connection they permit three variations of flow and one straight shut-off in any direction. Between every switch of these valves there is a complete shut-off position. This permits accurate throttling. But to insure even closer control, small by-passes and leads from the city pressure line are taken at intervals.

The three-way multi-port valves also facilitate pump priming. Even if the laboratory were not in operation for a long period of time, it would be possible to fill a tank with water from the city water mains. Then both pumps could take water from a tank considerably above either of them. With a set-up like this, priming offers no difficulties. A 90-deg. turn of a cone valve then switches the pump's source back to the reservoir.

Every sizable supply line has a venturi meter, and connections are so arranged that each one can be checked against at least one other venturi meter and any number of weirs. Of course, the venturi meters can be checked volumetrically, and in the case of the smaller ones, they can be checked by weight also. Furthermore, each venturi meter manometer is provided with a calibrated sliding scale reading directly in cfs or gpm as well as in inches. With the sliding scale, the zero is lined up with the lower column, and the flow is read directly.

The use of such a scale eliminates subtraction and the use of charts. This is a big help in rapidly throttling and controlling the flow to a predetermined amount. Thus, in a simple weir experiment, even increments of flow can be had very simply.

The laboratory is built on three levels. On the upper balcony is a constant head tank which can be fed by either or both of the pumps. The incoming water goes through a gravel stilling screen and then over a com-

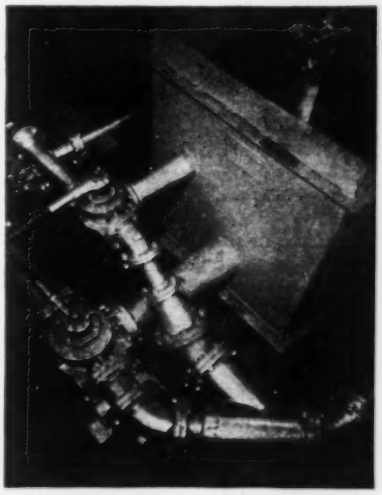


Fig. 1. Constant-head tank with valve and pipe connections which permit many variations in flow conditions.

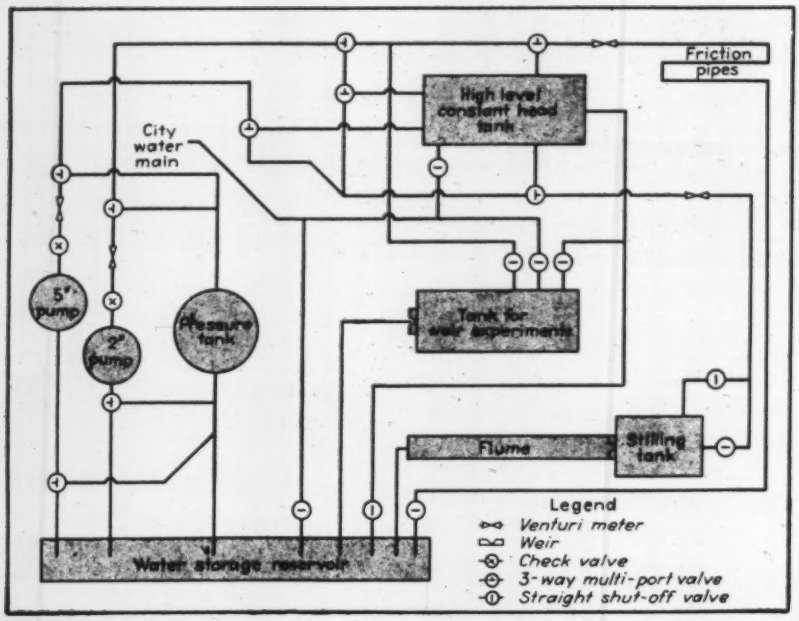


Fig. 2. Hook-up diagram of the hydraulics laboratory at Washington University.

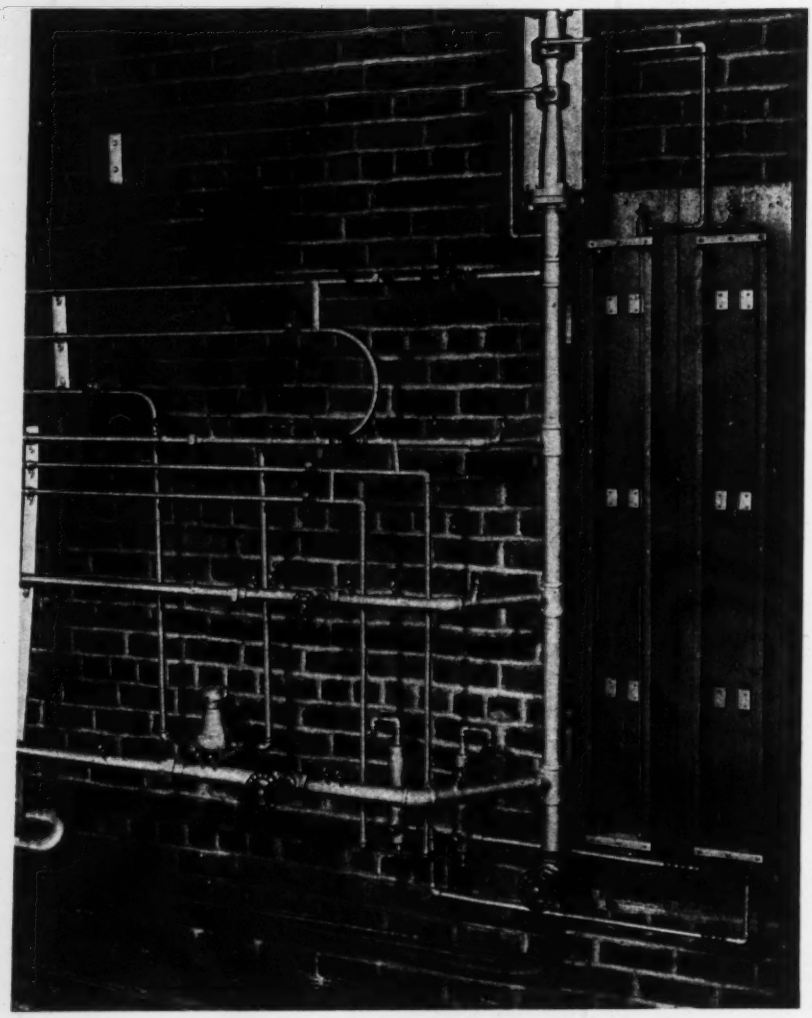


Fig. 3. Friction pipe rack and manometer layout. There are 80 ft. of pipe in each run of four sizes, and each run contains fittings of all kinds.

bination of flat horizontal weirs. A collecting trough gets the excess water, which can be wasted through an 8-in. line leading to the reservoir. Thus the surface of the water in this tank is kept at a constant level and water can be drawn in either or both of two discharge lines.

One of these discharge lines, the 4-in. pipe, leads to a tank on the lower balcony. The water fed into this tank passes through a stilling screen, and it can be discharged through weirs or orifices. These are built in removable plates and can be changed easily.

Flexible flume design

The larger 8-in. discharge line leading from the constant head tank empties into a stilling tank on the ground floor. This tank usually serves a flume. However, with part of the flume removed, the water can be diverted to large models, or one section of the flume can be removed and a wider part can be substituted. Smaller model studies can be carried on in this section.

The 30-ft. steel flume is so constructed that by means of adjustable supports the rate of grade can be changed. The flume has several joints. One long continuous grade is possible, or a combination of grades can be worked out to study flow in channels. Sand will be dusted over wet varnish on the inside surfaces of this flume to vary the roughness and to alter the friction factor. The flow in the line serving the flume can be accurately controlled by several valves as well as with a smaller bypass line.

Friction pipe rack

Another feature of the laboratory is a friction pipe rack. This can be fed by a direct connection to the small pump or by a connection to the pressure tank (the latter is served by the large pump).

Four of the common small sizes of pipe are used in these runs, and each line doubles back on itself. Thus there are nearly 80 ft. of each size pipe run in a 28-ft. horizontal space. A vertical 2-in. line with a venturi meter in it is the source of water for each run at one end, and another 2-in. line collects the discharge at the other end. From here it passes through a 2-in. water meter. After this, the water is collected and measured volumetrically or by weight.

and then drained back into the reservoir.

Each pipe run includes one long length of pipe in addition to an assortment of various fittings. The latter are separated by short lengths of pipe, and provision is made for manometer take-offs three diameters before, and five diameters after, each fitting. Each line is provided with a water meter, and eventually they will be accurately calibrated so that some time can be saved in regulating and computing flow. Unions are installed in the friction runs at intervals so that additional fittings may be substituted.

Manometer connections

Manometer leads on the friction runs are designed so that connections can be made easily and at the same time there will be no disturbance to flow. To accomplish this, short pieces of quarter-inch pipe were welded to the pipe in the friction run wherever there was to be a manometer take-off. After the welding had been completed, a hole was drilled in the friction pipe as large as the inside diameter of the short quarter-inch pipe, and then the drilling burr was removed from the inside of the pipe. A brass petcock was attached to the threaded end of each of the quarter-inch pipes.

Rubber tubing is used to connect manometer take-offs to the manometer. One manometer serving the friction runs is mounted permanently, and two long service pipes are attached permanently by pipe fittings to each of the column tubes. The pipes which are permanently connected with the manometer, are fitted with brass petcocks at close intervals; thus the mounted manometer can be hooked up to any fitting, any length of pipe, or any combination of fittings and pipe in the 28-ft. friction rack with two pieces of rubber tubing.

In getting the pressure drop through a fitting, any discrepancy due to friction in the service pipes can be eliminated by reversing the columns and averaging the readings. By using red oil with a specific gravity of 0.80, the pressure drop in any fitting in inches or feet of water can be measured with a magnification of five.

A portable manometer, which can be used with either mercury or carbon tetrachloride, can be applied to any fitting or combination with a sizable pressure drop. The service lines can also be made to serve this manometer in the case of two widely separated manometer take-offs.

The manometers were built in the department, and were made with standard bronze elbows and tees, brass pipe, glass tubing, indicator fittings, brass valves and petcocks. The petcocks take care of air vents and drains. At the top of each tube, plugged tees are used in place of elbows. After removing the plug in the tee, the glass tube can easily be cleaned with a wire-handled brush.

Tuning-up a Large Filter Plant

***Contents in Brief**—To put the Milwaukee filtration plant into shape for maximum operating efficiency, a number of minor changes and adjustments of equipment were required. These were described by James Kerslake, superintendent, at a recent meeting of the Illinois section of the American Water Works Association, of which the following is an abstract.*

TUNING-UP the 200-mgd Milwaukee water filtration plant was accomplished in a year and involved certain additions and replacements of equipment as well as adjustments. The plant was described in *Engineering News Record*, May 31, 1934, p. 709. Additions other than those provided in the original plan included (1) installation of two 36-in. valves in the pipe gallery so that the wash-water could be cut off individually from each quarter; (2) placement of Dresser couplings for the insertion of a cutoff plate on the discharge line of all pumps so that each cone valve could be isolated individually (otherwise it would have been necessary to cut out an entire row of pumps when making repairs to the cone valve; and (3) installation of glass block windows in the filter building to reduce condensation.

Equipment replacement included the substitution of two centrifugal sampling pumps for plunger pumps because the latter, under continuous operation without air chambers, prevented collection of representative samples.

Corrections and adjustments to various pieces of equipment included the following:

Meters—Before the meters would operate properly, a complete check of the wiring was necessary to eliminate cross-connections in the two loop supply circuits. Because of the collection of air in the venturi tube piezometer rings, float-operated air-vent valves were also installed. The air caused faulty differentials to be transmitted to the meters.

Filter Valves—Larger guide rails and new discs were installed on all 36-in. washwater valves. The 20-in. surface wash valves were sent back to the factory for repairs similar to the washwater valves. The lower discs of the two-disc effluent valves were replaced and the rails adjusted to obtain better seating.

Rate Controllers — An automatic shut-off valve was installed in the pressure line from the venturi throat to the under side of the diaphragm which operated to close this line with the action of the effluent valve. This prevented the controller diaphragms from being reversed, which in consequence caused certain parts to become jammed and bent. No such reversal was obtained in an 8-in. model tested in a hydraulic laboratory prior to the installation.

It was also necessary to repack some of the guillotine valve spindles due to sticking. As shipped from the factory, the packing gland was hermetically sealed, and it was necessary to make a cut with a special tool in order to insert packing rings. Once the packing rings are inserted, it is a simple matter to repack the valves as needed.

Flocculators—All of the gears on the flocculators after four months of operation showed excessive wear on the gear and pinion. This was due primarily to the failure of the two vertical shaft bearings and the horizontal bearing nearest the gear. The material used in the bearings (layers of canvas impregnated with a hardened plastic) was badly worn. These bearings were replaced with a lubricated bronze sleeve type of bearing. The misalignment of the shafts was corrected and new pinions and gears

Fig. 1. One of two main operating aisles in Milwaukee water filtration plant.

installed. The new gears are made of a different material containing molybdenum and is specially heat-treated. The advantage of this material is that it is much harder and can be cast with minimum warping.

Chlorinators — These proved to be satisfactory, with only slight trouble due to the collection of gum in the selector valve on the control panel adjacent to the ton containers. To date this trouble has been held to a minimum by periodical cleaning. It is being given further study in co-operation with the manufacturer of the equipment.

Baffles—As recommended by the contractor furnishing the mixing equipment, the baffles in the mixing basin were lowered 7 ft., decreasing the clearance from 10 to 3 ft. It is believed that this has helped to prevent short circuiting, and also that a better formed and more rapidly settling "floc" has resulted since this change was made.

Chemical Feeders—A screw type removable conveyor was added to the lime machine to convey the material from the feed belt to the drum. The sprays in the drum were rearranged to keep the drum clean, and some of the sprays were connected directly to the hot water system to increase the temperature of the mixture in the drum. Better operation would probably have been obtained if larger doses had been required, and the machine had been operated nearer its maximum capacity.

The alum machines are equipped with a stainless steel dissolving tank and their operation has proven satisfactory. The ammonium sulphate machines were repainted with acid-resisting paint.

Little trouble has been experienced with the carbon machines when feeding at low capacity. This does not hold true however when the machines are run near the maximum rate. Further studies are to be made and it may be necessary to put in larger vortex bowls and additional suction equipment for removing dust. A model of the carbon bag dump with the opening closer to the floor and with the reshaping of the dust hood so as to secure a more streamlined effect has been found satisfactory.

Storage of chemicals in quantity in steel bunkers has proved satisfactory for all materials excepting carbon. Recently a fire in the carbon bunker was extinguished with carbon dioxide gas. To combat fires the following recommendations are contemplated:

Keeping on hand an additional 200 lb. of carbon dioxide gas; equipping bunkers with explosion-proof doors, similar to those used on grain elevators; placing of indicating thermometers in each bunker; purchase of more metal cans for the storage of empty carbon bags in which to transport the bags to the incinerator; installation of automatic equipment which would flood the bunker with carbon dioxide when the temperature rises to a certain fixed point.

In the paper by James Kerslake, superintendent of the Milwaukee plant, from which this abstract was made, it was stated that both the designers and the constructors were to be complimented in producing a noteworthy flexibility in design which permitted adjustments under service.

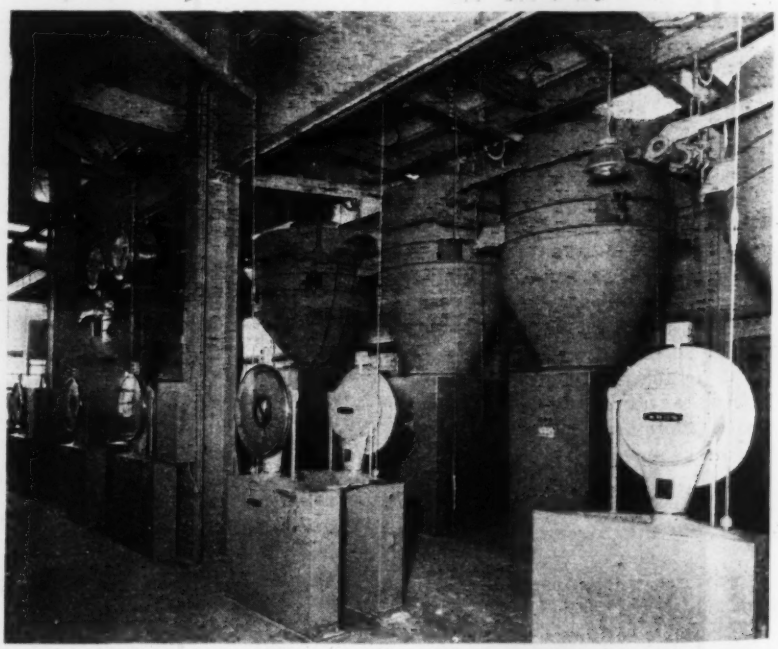


Fig. 2. Dry chemical feed room showing the steel storage bunkers, weigh hoppers, and feeding machines equipped with indicating devices.

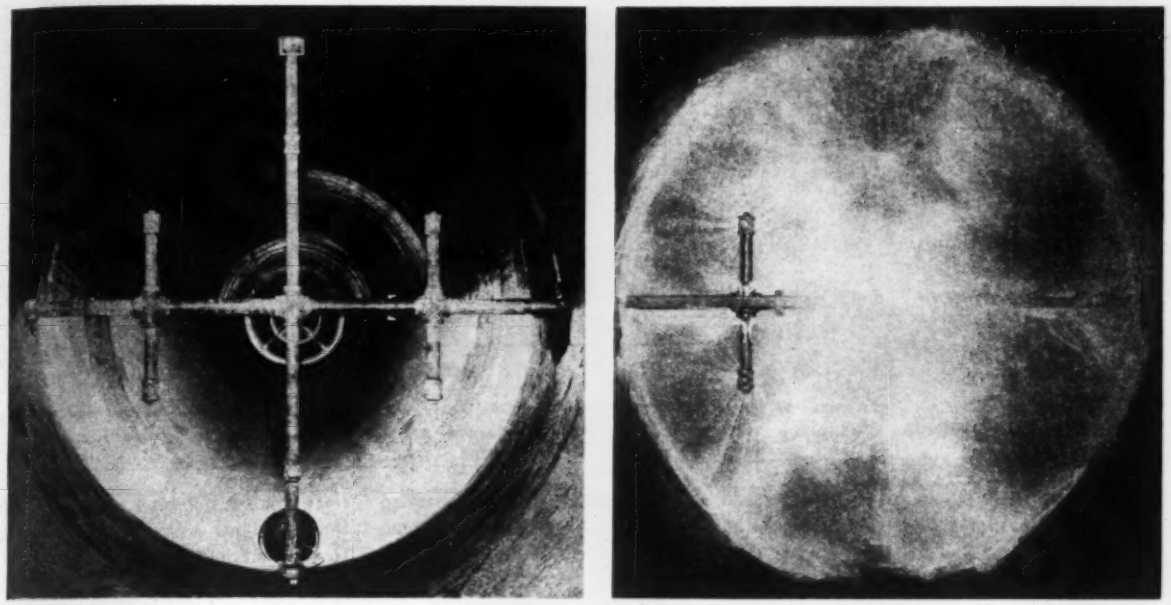


Fig. 1. Self-injection pop-valves in pipe of 10-ft. diameter. At right, pop valves in action, during adjustment.

Building Big Pumps Better Earns a Bonus

***Contents in Brief**—Expected records for high efficiency were attained in the 200-fps pumps that lift the new Southern California water supply 1,616 ft. above aqueduct intake level. The cash bonus on efficiency, offered as an inducement to manufacturers, began at 88 per cent; highest efficiency actually attained was 91.3 per cent. Surprise feature was prototype efficiency consistently lower than model tests led builders to hope.*

THE ADVANTAGES of obtaining high efficiencies in the large pumps on the Colorado River Aqueduct were so well appreciated in advance that (a) every endeavor was made to have the designs right, as indicated by the long series of model tests conducted at California Institute of Technology, and (b) inducement to the manufacturers to do their best was assured by offer of a cash bonus for developing efficiency above the stipulated value. Now that tests on the pumping plants in actual operation have been completed, outstanding efficiencies can be reported.

At the same time, there is also the notable finding that the prototypes did not develop efficiencies quite as high as had been predicted on the basis of model test studies. This surprising result attaches special interest to the conditions and test findings which are outlined below.

There are five pumping plants along the aqueduct which will each have nine pumping units in the ultimate installation, lifting the water a total of 1,616 ft. Three units have been put in each plant in the initial installation completed last year on which tests have now been made. Thus there are now a total of 15 units ready to operate. Each of these pumps, the specifications say, must deliver not less than 200 fps with an efficiency of at least 88 per cent.

The pumps are vertical shaft, centrifugal volute type, without guide vanes. They are direct-connected to 4,300, 9,000, and 12,500-hp synchronous motors, depending upon the plant head. Settings are such that they operate under positive inlet heads. Although the discharge head varies at the different plants from 146 to 444 fps, all plants are similar in general features and each pump unit is required to deliver 200 fps. An outline of the laboratory test program was published in *Engineering News-Record*, Jan. 14, 1937, p. 45, and the account of the pumping installation appeared Nov. 24, 1938, p. 673.

In making the efficiency tests, careful measurements were made of quantity of discharge, total dynamic head against which delivery was effected, power exerted by the driving motor and speed of rotation. In the measurements of each quantity, every known refinement which might affect results was taken into account. In addition to temperature corrections, allowances were made for changing densities in the water, differences in the acceleration of gravity at different elevations, and for every other minute correction that could be thought of which might affect values calculated to the fifth significant figure.

Making measurements

Electrical measurements were not difficult and, although subject to various corrections, the results were consistent and dependable. Power delivered to the motor was measured by meters in a container where tem-

Fig. 2. One of the two salt-velocity electrodes in position in the 10-ft. pipe.

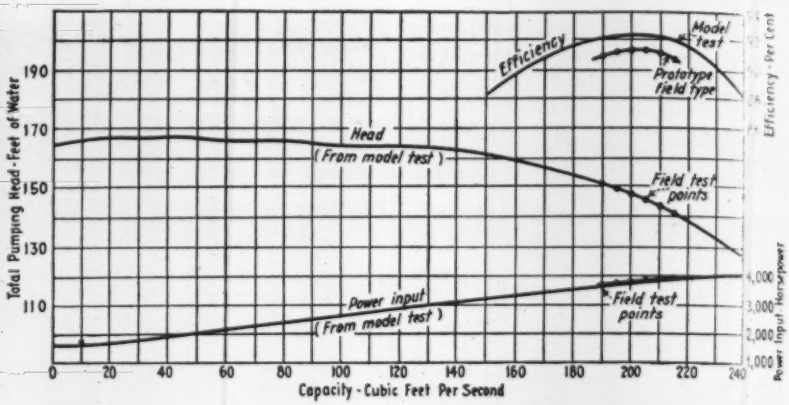


Fig. 3. Comparison of model tests with results of field tests on prototype, Iron Mountain plant. Note that model efficiency exceeds that of prototype.

perature was kept constant by electric heaters. Each motor had been tested at the factory and, when power input was measured in the pump tests, previously determined losses were deducted to get net power actually delivered to the pump shaft. Motor losses averaged less than 3 per cent; in other words, more than 97 per cent of the electrical energy was effective in driving pumps.

Speed of rotation was measured with a cathode-ray oscilloscope which compares the speed in cycles per second with a known constant speed source, thus giving accurate indication of revolutions per minute. The pumping heads were measured by mercury columns and by pressure gages that had been calibrated with known weights.

Salt test for velocity

An element of the tests to which particular interest attaches is the measurement of quantity of discharge, determined by the salt velocity method devised and developed by Prof. C. M. Allen of Worcester Polytechnic Institute. In this method a small volume of concentrated brine is quickly injected into the conduit and its time of travel between two sets of electrodes, placed a measured distance apart, is recorded electrically. For the field tests the brine was injected into the pipeline of 10-ft. diameter through six spring-loaded pop valves spaced evenly over the cross-section in a plane normal to the axis of the pipe, and upstream from the electrodes. A fast-moving recording ammeter made a chart record of the change in conductivity as the brine passed the electrodes. An independent calibrated timer marked seconds on the ammeter chart so that the time of passage between the electrodes could be measured directly from the charts.

Application of the salt velocity method was somewhat complicated by the relatively low velocities, only slightly more than 2 ft. per second. A check on the relative consistency of the water measurement was possible by the use of the venturi sections at the inlet to each pump. As each separate pump was tested, the venturi manometer was read and a relation obtained between the manometer reading and the discharge as shown by salt velocity. Two and three pumps were then operated together, salt velocity measurements made of their combined discharge (in the common discharge pipe), and compared with the sum of the individual pump discharges as indicated by the previously calibrated venturi manometers. Since the first results were not consistent, it was concluded that the low velocity plus an extremely smooth inside surface of the conduit created a condition in which turbulence was inadequate for satisfactory salt distribution.

The first tests were made with electrodes 400 ft. apart and the salt was injected 200 ft. upstream. A veritable field laboratory was set up and a long series of tests was made with different spacing of electrodes and various locations of the pop valves. The final arrangement was a spacing of 100 ft. between electrodes with the injection valve set 100 ft. upstream from the nearest electrode and an artificial agitator or "turbulator" about 40 ft. upstream from the pop valves. The "turbulator" was a steel disc 6 ft. in diameter with an 18x24-in. hole in its center, fastened transversely in the center of the 10-ft. delivery pipe. With this arrangement consistent results were obtained

TABLE I—GENERAL DATA AND EFFICIENCIES RECENTLY DETERMINED FOR PUMPS IN THE FIVE PLANTS

	Distance from intake (miles)	Average pumping head (ft.)	Runner speed (rpm)	Motor rating (hp)	Specific speed	Pump discharge diameter (in.)	Impeller diameter (in.)	Avg. discharge at rated head (fps.)	Avg. efficiency (per cent)
Intake	0	294	400	9,000	1,690	42	76	216	90.9
Gene	3	310	400	9,000	1,624	42	78	217	90.9
Iron Mt.	69	146	300	4,300	2,140	48	74-1/8	204	91.3
Eagle Mt.	110	440	450	12,500	1,403	40.5	81-5/16	204	89.6
Hayfield	126	444	450	12,500	1,395	40.5	81-15/16	204	89.9

TABLE II—AMOUNT OF SALT USED IN VELOCITY TESTS

	Number of Test Runs						
Station	One pump	Two pumps	Three pumps	Total	Total salt injections	Salt used (tons)	Salt per injection (lb.)
Intake	44	4	0	48	340	20.3	119
Gene	82	12	19	113	972	25.9	53
Iron Mountain	59	16	5	80	744	13.9	37
Eagle Mountain	24	3	3	30	308	7.2	47
Totals	209	35	27	271	2,364	67.3	*57

* Average.

between discharge measurements on single pumps and two or three pumps operating together.

Reservoir used as a tank

The use of the venturi manometers gave a check only on the consistency of the water measurement from the low velocity with single pump flow to the higher velocity with three-pump flow. It was not an absolute check on the accuracy of the salt velocity measurement. To provide a means of volumetric check, the reservoir on the intake side of Iron Mountain pumping plant was used as a container in which water quantities could be accurately measured. This reservoir is lined with asphaltic concrete and the slopes are smooth and regular. The reservoir was carefully surveyed and its volume computed for all water levels between El. 895 and El. 902, a total of about 70 acre-feet.

Five gages for determining water elevation were installed; one vertical gage near the center of the basin and four slope gages uniformly spaced around the edge. All these were read at intervals during the check runs. Just prior to the check runs, a 21-hr. static check of the reservoir was made to determine corrections for gains by cooling water and losses by evaporation and leakage. The volumetric check runs verified the accuracy of the salt velocity measurements, which were then accepted as satisfactory by all parties to the test.

All fifteen of the pumps thus far installed have met the required 88 per cent efficiency and are above the required capacity of 200 sec.-ft. The bonus rate for each per cent above the guarantee was $10,000 at Intake and Gene, $5,000 at Iron Mountain, and $15,000 at Eagle Mountain and Hayfield. The efficiency of 91.3 earned for the manufacturer a bonus of $16,500.

Personnel

Pump tests were conducted by the Metropolitan Water District of Southern California, F. E. Weymouth, chief engineer and general manager, under the direction of J. M. Gaylord, chief electrical engineer, and R. M. Peabody, principal assistant. In the salt velocity method tests Prof Allen was represented by E. A. Taylor and L. J. Hooper. Manufacturers' representatives were present at all tests.

Automatic Welding for Water Mains

***Contents in Brief**—Steel water pipe additions to the New York City distribution system are fabricated by an automatic electric welding process. This article describes the methods used and the specifications under which the pipe is tested.*

RECENT IMPROVEMENTS to the New York City water distribution system include the use of 48-in. pipe made from steel plate longitudinally welded by an automatic electric process. The Department of Water Supply, Gas and Electricity, under whose direction the work is being done, figures an average overall cost, including construction, laying and cost of the pipe itself, at $25 per ft. for this type of welded pipe, while a few years ago the cost alone of the type of pipe used often approximated $20 per ft., before taking into consideration the construction labor costs.

Two projects are under way, one in Queens County and the other in midtown Manhattan. The Queens job consists of laying 13,800 ft. of a new trunk main which will supply 25 mgd and thus relieve the heavy burden of water demand on existing water lines. This work, costing $344,700, is being done by the Oakhill Contracting Co., Maspeth, L. I. The same contractor received $98,000 for laying about 1,000 ft. of the 48-in. pipe in Manhattan, with another 1,000 ft. of pipe laid as miscellaneous replacements of worn sections of existing lines.

The pipe used on these projects is made from ½-in. steel plate (A.S.T.M. designation A 78, Grade B) formed by cold-rolling into semi-circular shape. Longitudinal welds are used to join two of these shapes and thus complete the pipe, the welds being made by the Unionmelt process, an automatic electric welding process developed by The Linde Air Products Company. In this process there is no visible arc, and there are no sparks, spatter, smoke or flash. The welds are said to be made at unusual speeds.

Special material is key to process

A bare welding rod is continuously fed into the welding zone by the Unionmelt welding head, and the end of the rod is constantly covered by a special granulated material known as Unionmelt welding composition. This composition is automatically laid down in advance along the seam to be welded. This material acts as a cleanser for the weld metal, washing the metal which melts from the rod and absorbing impurities from the fused base metal. The weld metal is said to be exceptionally clean and dense, and has excellent physical properties.

A number of etched cross-sections of one-pass butt welds made by the Unionmelt process in ¼, ⅜, ½, 1 and 1½-in. steel plate are shown in Fig. 1. All welds illustrated are about actual

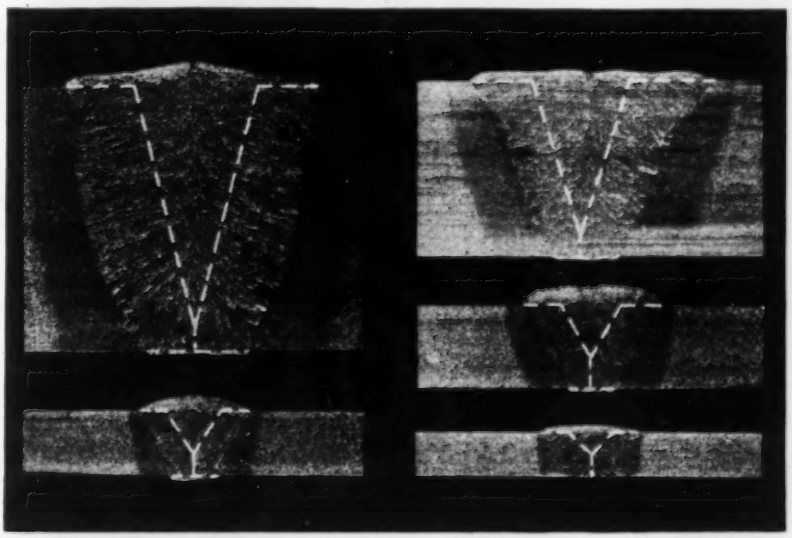


Fig. 1. Etched cross-sections of one-pass butt welds made by the Unionmelt process.

size; the dotted lines indicate the original plate edges.

The automatic machine

The installation used in the fabrication of this pipe is shown in Fig. 2. The welding head, shown in position for the start of a weld, is stationary, and the work is mounted on a movable carriage. Welding is done entirely automatically at a speed of 18 in. per min., with the machine using 800 amp. and 32 volts. The appearance of the finished weld is shown at right in Fig. 2.

Procedures for testing and coating the pipe are in accordance with the specifications set by the Department of Water Supply, Gas and Electricity. Specimens must be prepared from one of every ten pipe lengths for tension and bending tests, while each pipe length is subjected to hydrostatic test. These are shop tests. In the field the entire line is subjected in section to a further hydrostatic test.

Test specifications

Test specimens for bending and tension must be at least 14 in. long with the weld running crosswise at its center, and the specimens are machined to a width of 1½ in. The specimens must develop an average ultimate tensile strength of not less than 50,000 lb. per sq.in.; must be tested to destruction and break outside the weld. Of the specimens broken outside the weld, not more than 20 per cent may be allowed to show a tensile strength of less than 50,000 lb. per sq.in., and no specimen will be accepted which does not show a strength of at least 45,000 lb. per sq.in.

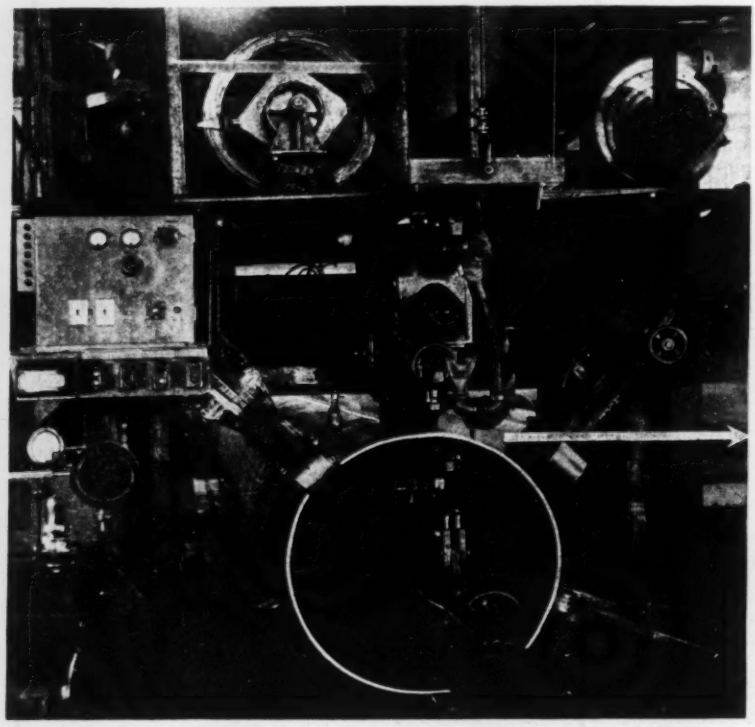
Each bend-test specimen must be taken from the same sample as the corresponding specimen used for tension testing. These test specimens must in each case, and without showing evidence of fracture either in the weld or the parent metal, be bent cold through 180 deg. around a 2¼-in. diameter with the weld in the center of the bend.

Before being coated, each completed straight pipe section is tested and made tight at the shop under a hydrostatic pressure of 150 lb. per sq.in. The welds are struck a full swinging blow with a 5-lb. sledge hammer while this pressure is maintained. The pressure is then raised to 300 lb. per sq.in. If no leaks develop at the end of three minutes, the pipe length is acceptable. It is then coated both inside and out with a coal tar enamel, applied by the spinning method.

Fig. 3. Finished 40-ft. sections of the pipe being installed.

The city's specifications require the main to be hydrostatically tested in sections of about 1,000 ft., each blocked off by means of bulkheads. The sections are then filled with water under a pressure of 125 lb. per sq.in., maintained for 20 min. Maximum leakage allowance, figured on a 24-hr. basis, is ¾ gal. per lin. ft. of pipe.

Plans and specifications for this work were prepared under the direction of T. Hochlerner, division engineer of the New York City Department of Water Supply, Gas and Electricity, of which Patrick Quilty is chief engineer and William Flannery, deputy chief engineer.



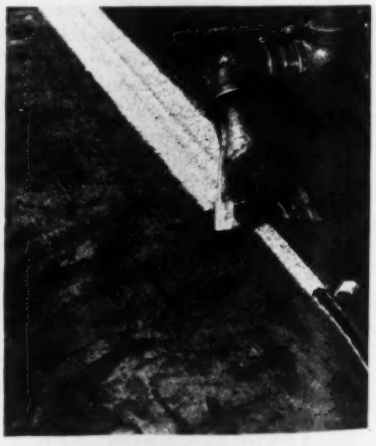


Fig. 2. Fabricating the 48-in. pipe from ½-in. steel plate longitudinally welded. The welding head is stationary and the work is mounted on a movable carriage. The illustration at the right shows a completed weld.

Cleveland's Huge Screen Well Completed by WPA Workers

ONE OF THE BIGGEST water screen wells in the world has been excavated at Cleveland, Ohio, where 300 WPA workers have completed ten months of blasting and digging into a shale bank on the site of the Nottingham pumping and filtration plant that one day will provide the northeast metropolitan area with a 200-mgd. lake water supply.

Water will be drawn through a tunnel connecting the well with an intake to be constructed five miles off the Lake Erie shore. The tunnel will be built 50 ft. underneath the lake bottom, and it will have an overall length of nearly seven miles. Raw water will be carried through the 11-ft. tunnel to the screen well, from which conduits will take it to a chemical house for pre-treatment, and then to coagulation and filter basins. Treated water will be stored in a reservoir from which it will be pumped to the distribution mains as required.

Excavations for the first units of the treatment plant—the screen well, a filtration basin and six coagulation basins—have already been completed by WPA labor forces.

Much dynamite used

The screen well, with a capacity of 50,000,000 gal. of water measures 103 ft. in diameter and is 110 ft. deep. The excavation involved removal of 10,000 cu.yd. of shale, blasted out by 30,000 lb. of dynamite.

Dynamite charges, as much as 100 lb. to the shot, were set off each evening after the men quit work for the day. The resulting blocks of shale were then cracked up with air-driven rock busters and removed with skips. Despite the hazardous nature of the work, it is reported that there never has been a serious accident on the project.

The specialist work of driving the tunnel under the lake, using compressed air, will be done by private contract.

Fig. 1. With a diameter of 103 ft. and a depth of 110 ft., the screen well for Cleveland's new water plant ranks as one of the world's largest. It was excavated in shale, and has a capacity of 50,000,000 gal.

Ground was broken on the project in October, 1938. Work progressed until July, 1939, when the work was shut down until last March. During these periods of operation the well has been dug and excavations completed for the coagulation and filter bed, 720 ft. long and 600 ft. wide, and for the reservoir that will have a capacity of 500,000,000 gal. Concrete work on these units will be completed next fall. When the Nottingham plant is completed its 200-mgd capacity will supplement the 135-mgd supply from the Baldwin filtration plant.

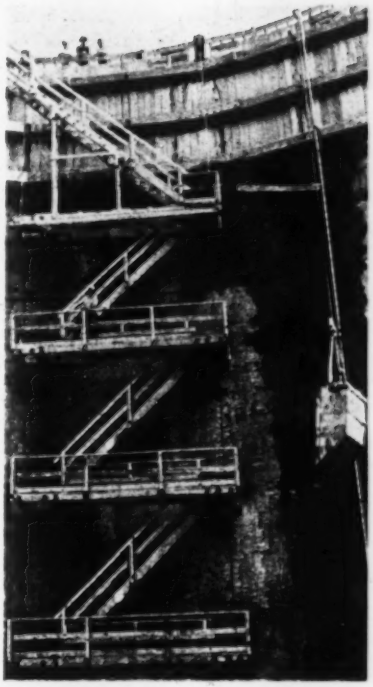
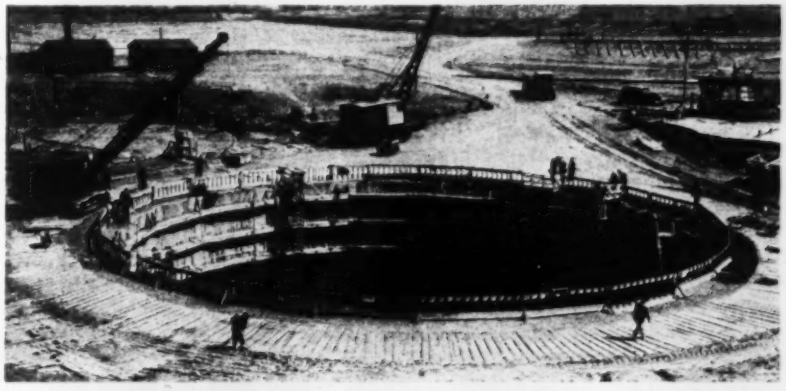


Fig. 2. A sturdy stairway supported by cables insured the safety of workmen going up and down.



Baltimore's New Water Tunnel

Leon Small
Water Engineer, Bureau of Water Supply
Baltimore, Md.

Contents in Brief—A seven-mile pressure tunnel now nearing completion at Baltimore gives to that city a long-needed supplementary conduit to its source of supply. Dealing primarily with design considerations, the following story also carries with it the lessons learned from construction of the original tunnel in 1875. An unusual feature of the project is the eductor system to be used for unwatering the conduit.

FOR MORE THAN HALF A CENTURY Baltimore placed dependence on a single conduit for the delivery of its raw water supply. Increasing water consumption demands, plus a strong desire to insure continuity of supply, led to the construction of a new tunnel which is now nearing completion. The contract for this project, which was the largest single award ever executed by the city, was made in January, 1937, to the J. F. Shea Co., Inc., of Los Angeles.

The new pressure tunnel is a 34,600-ft. bore having a finished inside diameter of 12 ft., coupled with a 2,100-ft. cut-and-cover section. Two-thirds of the tunnel has a concrete lining, and about 12,000 ft. is lined with continuous welded steel plate grouted inside a previously placed concrete lining. The conduit, known as the Gunpowder Falls-Montebello tunnel, has a capacity of 275 mgd. The project cost about $5,400,000.

The old Loch Raven Tunnel, started in 1875 and completed in 1881, is a 12-ft.-diameter, 7-mile conduit, most of which is unlined. Such lining as exists is of brick, limited to the closure of construction shaft openings and the lining of a short section through a limestone formation. No thought of improving the hydraulics of the old tunnel was connected with the lining, ample evidence of this being found in the many irregular sections where lining was not attempted.

As originally built, the tunnel was designed on the basis of a very low head, the intrados of the arch at the beginning of the tunnel being but 8 ft. below the normal water surface of the original Loch Raven Reservoir. The maximum possible increase in hydraulic pressure at the terminal end of the tunnel is only 7 ft. more than the head represented by these dimensions, the grade of the tunnel falling uniformly one foot per mile on its 7-mile length.

In 1914 the Loch Raven Reservoir was impounded behind a new and higher dam which, in connection with changes at the terminal end of the tunnel made to deliver water to the newly built filtration plant, imposed a pressure increase of 20 ft. To provide for this increase a section of the tunnel at the upper end, where the cover was very shallow, was reinforced with concrete lining. This reduced the effective area in this section from 12 to 10 ft. in diameter.

In 1923 the reservoir was raised to a still greater height. Had the old tunnel been able to handle the increased head resulting from raising the dam, it would have permitted delivery of all water to the Montebello filters without pumping, a procedure that has been required since the filters were placed in service. Pressure tests made on the tunnel in 1920 demonstrated conclusively that an increase in working head of 30 ft. over the head initially imposed on it resulted in excessive leakage and other manifestations that were anything but desirable. As a result, the tunnel has for the past seventeen years received water from which 40 ft. of head has normally been wasted. This has cost the city real money as evidenced by an annual pumping cost of $70,000.

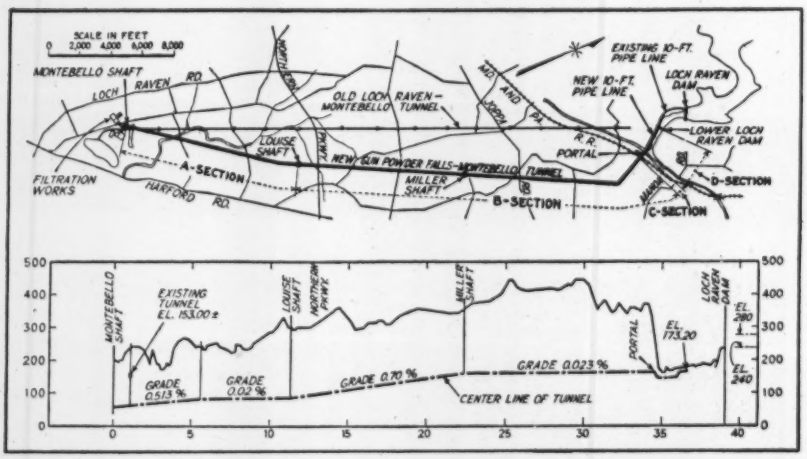


Fig. 1. Route of the new 7-mile pressure tunnel at Baltimore, which connects the raw water supply with the filtration works. This will replace an unlined tunnel in use since 1881.

New tunnel needed

Deficiencies of the Loch Raven Tunnel were painfully evident. Despite the many improvements to render better service, operation of the entire system was dependent on the functioning of one raw water connection through a structure having a capacity of 175 mgd at a head loss of 10 ft.

In 1934 a board of consultants engaged to study water supply problems recommended immediate construction of a new tunnel. The conclusions of the board regarding the old tunnel were succinctly expressed as follows: ". . . it is our judgment that a population of approximately one million people should not be left dependent solely upon one conduit, portions of which are not in good condition."

With the availability of federal funds as a stimulus, the long-desired duplicate raw water supply line be-

Fig. 2. Excavation completed, concrete curbs in place, and ready for the lining operations on the 12-ft.-diameter conduit.

came a possibility and the planning for this structure was begun on the basis of having a capacity of 275 mgd with a loss of head of 10 ft.

Selecting the route

In selecting the tunnel route there was little latitude in the location of the two ends, the available raw water supply and its necessary point of delivery being fixed. It is of interest to note that the route for the old tunnel between these points apparently gave its designers little concern, the line of this structure being a tangent for practically all of its distance; and the quality of the rock and its minimum cover along the route apparently was considered of small moment, due to the very low head under which this tunnel was designed to operate.

Furthermore, the selection of this original route was not assisted by preliminary explorations as far as available records reveal. If such work was done, but little attention could have been paid to the information obtained because the tunnel obliquely crosses a valley that lies in a limestone formation which gave a great deal of trouble during construction. Excessive water and unstable ground made it necessary to provide continuous lining to give permanence to the structure at this section. After leaving the valley the old tunnel enters and thereafter is in a rock formation locally classified as Gunpowder granite. This has characteristics that promised well for tunnel excavation in similar material.

Geological maps of the area indicated that this granitic formation extended upward along the valley near Loch Raven where the limestone was encountered in the construction of the old tunnel. This furnished sound guidance in selecting the new route along a line which gradually diverges from the course of the old tunnel. Thus the route was kept well within the confines of the geologically sound material until an abrupt change in direction to reach Loch Raven was necessary. This changed direction crosses the indicated limestone formation nearly at right angles, and therefore the tunnel traverses this undesirable formation in the shortest distance.

Centerline in streets

An added consideration in the selection of a route divergent from the old tunnel was to minimize the possibility of a coincident seismic disturbance, remote as this may be. The final route was adjusted slightly so as to have the centerline of the tunnel fall within public streets where this was practicable, in order to minimize right-of-way negotiations through private property.

Since the elevation of the reservoir normally is sufficient to deliver raw water without pumping to the filtration plants the new tunnel was designed to withstand the pressure which would be imposed upon it, not only from the present reservoir level, but from a possible additional head of 50 ft. that may result from the further development of the Gunpowder Falls supply. To attain this end, as well as to give assurance that the excavation would be driven in sound rock, the grade of the tunnel in those portions not provided with a lining designed to resist internal pressure was located at depths varying from 200 to almost 300 ft. beneath the surface. The elevation at the terminal end, near the point where the new tunnel passes beneath the old one, was such that a depth of 80 ft. exists between the invert of the old tunnel and the intrados of the new one. This was sufficient separation to insure the stability of the old tunnel while the new one was driven beneath it.

Checking the ground

With line and grade of the proposed tunnel tentatively fixed, the location of points for 18 core borings was selected. Ten of these were closely spaced at the ends of tunnel, at construction shafts and other points where it was considered desirable to obtain all available information. The greatest separation of the borings was about 3,300 ft.

The contract for these borings called for drilling, removing and preserving all solid material encountered from the ground surface to levels 10 ft. below the invert of the proposed tunnel. Core borings to a total combined depth of 3,620 feet were taken; the earth overburden encountered had an average depth of 27 ft. and of the total 3,133 ft. of solid rock drilled, the core recovery represented slightly more than 95 per cent of this penetration. This was considered an excellent indication of the soundness of the material.

The report of the consulting geologist forecast that rock conditions would be sound and satisfactory throughout the tunnel. With this information, the route was selected as shown in Fig. 1. This sketch shows also the relation between the old Loch Raven-Montebello Tunnel and the new construction.

Design features

At the Loch Raven end the tunnel begins in a portal near the foot of a steep hillside, the slope of the hill being such that when the tunnel penetrated a distance of 400 ft. the ground cover attained a depth of about 150 ft. From the portal the grade of the tunnel slopes downward toward the terminal end at Montebello, this

gradient changing as necessary to accommodate the gradual reduction in ground surface elevation. The purpose of the gradient changes was to have the greater length of the tunnel (indicated as B section in Fig. 1) which is not reinforced for internal pressure, located at a sufficient depth in rock to have it capable of withstanding safely pressure from a future reservoir with maximum flow line at El. 290.

In addition to access to the tunnel afforded by the terminal shaft at Montebello and at the portal, further access for construction was planned at two intermediate shafts, one of these being located about midway the B section and the other at the lower end of this section. Between the latter shaft and Montebello, the ground surface falls rapidly below El. 290 and this section of the tunnel route in addition is traversed by a small stream running through a deep valley.

This stream contributed more than its proper share of trouble during the construction of the old tunnel and for this reason was viewed with distrust. The loss in elevation of sound supporting rock, the presence of the stream and the fact that the ground elevation approaching the terminal shaft at Montebello falls generally below the present hydraulic gradient of the tunnel (and entirely below it if the source of the raw water supply is raised to El. 290) led to the decision that this portion of the tunnel, designated as A section, should be one that would be entirely watertight and capable of withstanding the pressure from water at El. 290 without consideration of any support from the surrounding rock. For substantially the same reasons the first 400 ft. of the tunnel lining running inward from the portal was similarly designed, this being known as the C section, it being identical with the A section.

What has been stated about the general construction features includes all sections of the project involving tunneling work. As part of the project, but involving no tunneling, there is a 10-ft.-diameter steel pipeline, about 2,100 feet long, arranged to connect the tunnel at the portal with existing structures from which the raw water supply will be obtained. This portion of the work is known as the D section.

Concrete and steel lining

As indicated by Fig. 3 the essential differences between the A, B, and C sections relate to details of the lining. The lining varies to suit the conditions imposed upon it by the changes along the route of the tunnel in the depth of the rock cover and the elevation of the ground above.

The lining for the A and C sections consists of a previously formed unreinforced concrete lining placed within the rock excavation, having a specified internal diameter sufficiently great to permit a 2-in. annular space between the concrete and the outside surface of steel plate pipe; however, the contractor elected to increase this grout space to $2\frac{1}{2}$ in. as a matter of convenience in handling the steel pipe sections. The preliminary lining is of Grade III concrete (1,500 pounds) and to assure its proper placement a minimum excavation clearance line of 4 in. was specified between the interior face of the concrete and the rock.

Following the placing of the concrete lining, designed to afford a finished working area for the $\frac{1}{2}$-in. steel plate pipe which gives the necessary strength and water-tightness to the tunnel, the 40-ft. steel pipe sections were placed. These were electrically welded at all circumferential field joints to form a continuous structure, after which the annular space surrounding the pipe was filled with 1:2 cement grout, pumped through tapped holes in the sides and tops of the pipe lengths at 10-ft. intervals. After the pipe has been fixed in position by the grout placed exterior thereto, protection against internal corrosion is given by a $1\frac{1}{2}$-in. Gunite lining, this being applied to a reinforcing mesh previously secured to internal hoops, tack-welded to the steel pipe at 3-ft. intervals.

For lining the B section Grade 2 (2,000-lb.) concrete was placed in an excavation having a minimum clearance line of 6 in. between the inside surface of the lining and the nearest rock or support. The B section was located sufficiently deep in solid rock to afford a safe structure without the inclusion of reinforcement. Regardless of the hydraulic sufficiency of the tunnel bore, however, the concrete was reinforced for temperature stresses with $\frac{1}{2}$-in. longitudinal bars spaced on 8-in. centers and supported from the same size circumferential bars spaced on 3-ft. centers. This reinforcement was placed so as to have a cover of 2 in. from the interior surface of the lining.

Cut-and-cover section

The final portion of the construction, involving the D section, was open-cut work. For this section a 10-ft.-diameter steel plate pipe $\frac{1}{2}$ in. thick, electrically-welded in the field to form a continuous structure, was used. The pipe is protected from cor-

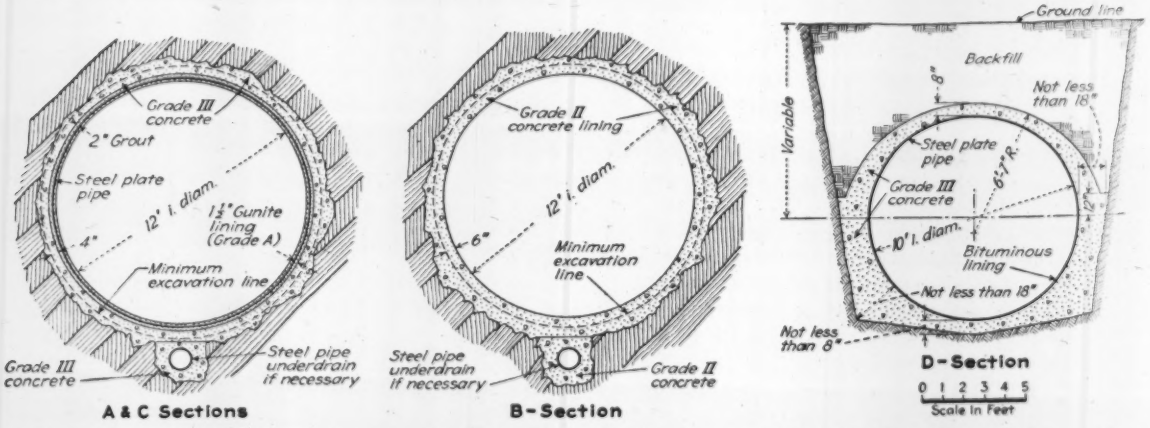


Fig. 3. Typical tunnel and open-cut sections of the conduit, parts of which have both concrete and steel linings.

Fig. 4. Simplicity is the prime virtue of the eductor system for unwatering the tunnel.

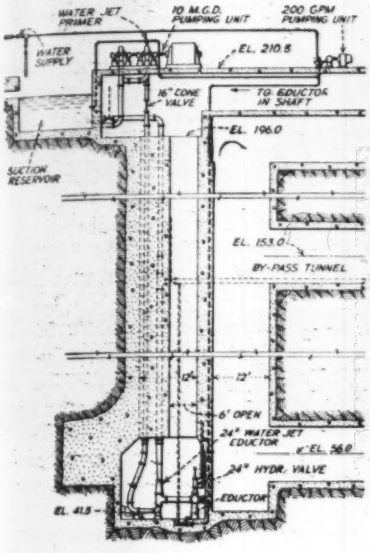


Fig. 5. The open-cut section where 10-ft.-diameter electrically welded steel plate pipe was encased in concrete to prevent exterior corrosion.

rosion on the inside by a bituminous enamel lining. To guard against exterior corrosion and distortion from the weight of the backfill and possible future surcharge, an unreinforced Grade 3 (1,500-lb.) concrete encasement was used. This has a minimum thickness at the crown of the arch of 8 in., the thickness of the concrete at other portions of the encasement being increased as necessary to give stability to the structure.

Some question may arise regarding the consistency of designing the D section with a 10-ft. diameter, whereas the tunnel supplied through this section is 12 ft. in size. The explanation is that the portal of the tunnel construction may be the site of a future reservoir gatehouse, and if this possibility materializes, the 2,100-ft. length of the D section will be scrapped. With this in mind, the diameter of the section was fixed at 10 ft. as a matter of economy; the same consideration determining the selection of a bituminous enamel protection for the interior surface, rather than the more costly Gunite protection used for the steel pipe incorporated in the lining of the A and C sections.

Unwatering provisions

The location of the tunnel deep in sound rock to attain structural stability, and the further depressing of the grade at the terminal end so as to have ample separation between the old and the new tunnel where they cross, places the center line of the terminal end of the tunnel 91 ft. below the level of the lowest available gravity drainage facility. This condition will result in having about 15 million gallons of water trapped in the tunnel when it is unwatered as far as gravity drainage can accomplish this. Accordingly, pumping must be resorted to whenever complete unwatering of the tunnel is desired. The studies that were made for the purpose of determining how this could best be accomplished focused attention on every practical means to such ends.

The unwatering method finally decided upon is shown schematically in Fig. 4. This arrangement, using an eductor, may have no particular appeal from the standpoint of "wire-to-water" efficiency, but it has virtues of simplicity and accessibility that go far to overcome the drawbacks possibly associated with an efficiency rating that may compare poorly with other methods of pumping.

It will be noted that a large motor supplies the power for the unwatering scheme, and some questions may arise as to the economics of the design, considering the infrequent use of this motor and the electrical demand charges usually associated with such equipment. The use of this motor will not incur additional demand charges, however. Any shutdown requiring the use of unwatering equipment will involve the stoppage of the filtration plants and a nearby distribution pumping station. This will reduce the load on a transformer bank, which also supplies the unwatering equipment, by an amount greater than the demand of the large unwatering motor.

How the eductor works

The main power element of the unwatering equipment consists of a 1,250-hp. motor, operating a 2-stage centrifugal pump of 10-mgd capacity when delivering against a net head of 570 ft. Suction for the pump is taken from an adjoining reservoir of 12,500-gal. capacity, the supply for this reservoir being taken from the distribution system. In operation the water discharged by the pump is hurled downward to the bottom of a dry shaft immediately adjoining the wet shaft through which the raw water from the tunnel rises to be distributed to the Montebello filters; this power water then enters a 24-in. eductor, the suction of which connects to the tunnel.

The flow of power water at the rate of 10 mgd into the eductor possesses sufficient energy to pick up a like quantity of tunnel water, with the result that water at the rate of 20 mgd rises through the return line from the eductor. As will be noted in Fig. 4, the return line leads to the suction reservoir, but a 24-in. drain line is located at the level of the lowest

available gravity drainage which is tapped off at an elevation about 100 ft. above the eductor suction. By manipulation of valves in the eductor suction connection and the gravity drainage outlet, the 20 million gallons of combined power and tunnel water can be separated so that one-half of this quantity is wasted, the remainder returning to the pump suction reservoir to begin a new cycle.

Obviously, the quantity of tunnel water drawn by the eductor will be at the maximum when the unwatering operation is started and the head against which the wasted water is discharged is at the minimum. As water is drawn from the tunnel the effective discharge head on the eductor will increase, resulting in a constantly changing working condition throughout the unwatering operation that can be compensated by manipulation of the valve in the return to the suction reservoir, in addition to the adjustment of the valves first mentioned.

In addition to the main unwatering unit a similar smaller unit, taking its suction directly from the distribution system, is provided for unwatering the dry shaft. This likewise supplies a water jet primer for the main pump unit.

Controlling the flow

Where the supply for the new tunnel is taken from the existing structures at Loch Raven, gate valves are provided to control the flow of water to the new or old tunnels. These valves, as well as all other line valves at the terminal end, are 60 in. in size, connected through eccentric reducers so as to have a drained invert. An automatic air vent installation is provided at the portal summit as well as at other points where necessary in the terminal construction.

From the Montebello shaft the water is discharged into a short horizontal manifold paralleling a similar manifold built into an existing raw water conduit connecting to the two filtration plants. The gravity supply to these plants is regulated by four 48x42-in. manually-operated needle valves installed in tie lines between the manifolds; each needle valve is preceded by a 48-in. manually-operated cone valve for shut-off.

In addition to the normal passage of the raw water through this flow control system, a short by-pass tunnel connects the Montebello shaft with the suction well of the pumping station through a short rebuilt section of the old tunnel. This permits water to be supplied to the filters by pumping if the reservoir at Loch Raven should be depleted to the extent that the gravity head would not be sufficient to meet the demand.

Construction methods and equipment on the Baltimore tunnel will be described in an article to follow.

Aurora Sewage Plant Problems

TWO DIFFICULTIES which arose in the operation of the two-stage digestion plan at the sewage treatment plant of the Aurora (Ill.) Sanitary District are noted in the annual report for 1939 by Walter A. Sperry, superintendent of the District.

Digester Blows Up—The first trouble was an unpleasant period in October and November when the first-stage digester "blew-up", probably due to lack of mixing devices in this stage. It was preceded by such a violent evolution of gas that the sludge concentrated in the top of the digester, plugged the gas lines and completely filled the whole gas system with sludge. Furthermore, this resulted in unusually heavy pressures, so that it was necessary partly to discharge the first-stage digester to restore order. As this condition may recur at intervals, it suggests the advisability of repairing the scum-breaking arm in this digester. The arm has not been in use since 1932, and it is thought possible that, when repaired, it will be sufficiently effective in reducing the nature and quantity of accumulation in the top of this digester. The cost would be small as compared to that of providing pumps and motors, which may ultimately be necessary to insure effective mixing.

Sludge Drying and Handling—A second trouble arose from the greatly shortened periods of storage in the second stage (as low as 35 days for No. 2), and this nearly proved disastrous for lack of time to dry the sludge on the beds. Low rainfall of uniform distribution, averaging 2 in. per month, resulted in a concentrated sewage which produced more effective removal in the clarifiers. This in turn produced raw and secondary sludge for the digesters with high content of volatile matter and thus reduced the ash content and the specific gravity of the sludge transferred to the second-stage digester. Thus the sludge tended to bulk in the digesters and so reduced the storage period. These shortened periods became critical in the fall, when drying conditions were unfavorable.

It was then decided to try the effect of alum in hastening the dewatering, as had been done successfully at Toronto and other places. After a successful experiment in September on one sludge bed, the digester discharges in November and December were given a full alum treatment of 400 lb. per bed, or at the rate of 1 lb. per 85 gal. of sludge, which is equivalent to 1.4 grains per liter.

A simple and easy method of application was devised. As 200 lb. of alum will dissolve readily in 50 gal. of water, three or four barrels were rigged up and equipped with a small pitcher-pump, funnel and hose. Then the alum solution was readily applied to the discharging sludge, at the entrance to the beds, by controlling the rate of pumping against the rate of bed filling.

Results of this treatment indicate that under summer conditions the drying time can be as short as 12 to 15 days. In winter, there is the advantage that the bed is practically dewatered within a 24-hour period. The bed must be frozen to be removed, and the cost is cut in half since alum-treated beds produce a 4-in. sludge cake, while on untreated beds the thickness is almost 8 in. Furthermore, while untreated beds are greatly retarded if caught by rain before "cracking", alum-treated beds tend to let the water through, with much less retardation of the drying process.

So successful was this treatment, that alum was stocked in carload lots at a saving of 25 per cent compared to retail trucking from the Chicago area. Carload purchase reduced the cost per discharge to ten beds (two tons of alum) from $63.50 to $48. In fact, the use of alum is credited with saving the plant from an almost disastrous period of operation, since it would have been left with full digesters and full beds in unfit condition for sludge removal.

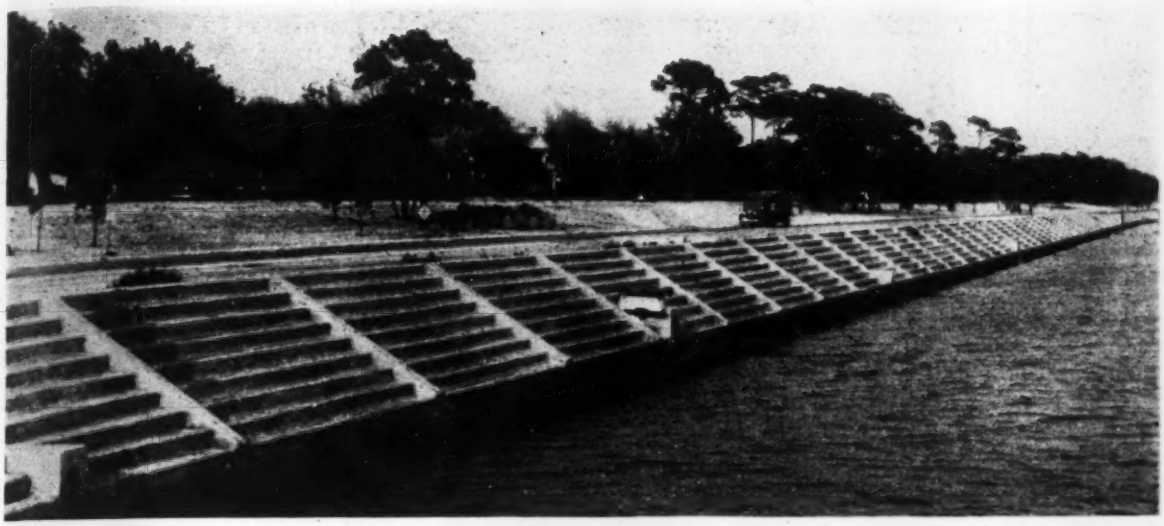


Fig. 1. A new road for the dual highway is below the old road on filled ground back of the seawall.

Gulf Coast Road Being Rebuilt As a Dual Highway

***Contents in Brief**—Reconstruction of the coast highway in Mississippi from Biloxi to Pass Christian is under way. The old road is to be repaved and used for westbound traffic and a new parallel road is being built back of the seawall to serve eastbound traffic. Concrete pavement is colored by use of emulsified carbon black to reduce glare.*

SIX MILES of the coast highway that runs for 26 miles through the resort area between Biloxi and Pass Christian in Mississippi is being converted from a narrow two-lane road to a dual highway with separated 24-ft. lanes for east and westbound traffic. The present road, U.S. 90, is both a service road for the hotels and homes that line the coast and the main through route to New Orleans from Mobile and points to the east. It runs through the pines and live oaks along the ocean side of the dunes and cannot be materially widened in most places without sacrifice of many trees and fine shrubs.

Some years ago a stepped seawall was built along most of this section of the coast to protect the dwellings on the dunes and to check erosion, the wall being set well out from the old road through most of its length to provide a wide shore area that was backfilled with sand up to the level of the top of the wall. This shore area has long been recognized as a possible site for a new road.

In 1937 the state highway department inaugurated a survey to determine the best location for a new road along the coast to relieve the congestion on the old one. It included a detail map that showed the location of all structures, subsurface utilities, trees and large shrubs from the seawall back to well beyond the old road. On this map a location was made for a two-lane highway that will serve for eastbound traffic, thus freeing the old road for westbound traffic. For much of its length the new road can be built some distance away from the old road, thus leaving a wide central strip in which the natural growth need not be disturbed. Many streets and side roads come into the old road making it necessary to provide crossroads between the two main traffic lanes, but the number of these crossroads is to be limited, and they are to be located at points where the topography and planting make it possible to build them with a minimum of change in the natural conditions.

The state is not purchasing the waterfront land from the riparian owners, but is taking an easement for the highway and is stipulating that no building can be put up in the region to be used by the highway. The old road is being rebuilt as part of the new work, minor changes being made in its location, chiefly to improve its alignment and to provide space for the installation of underground utilities in the future. There will be widened zones on both roads for bus stops and parking bays in order to take these vehicles out of the lanes of through traffic.

Construction work was begun in June, 1939, the work being performed as a WPA project sponsored by the highway department. The highway department provides equipment, most of the material and part of the skilled labor. The WPA provides the remainder of the labor and pays about one-sixth of the material cost. Efficiency of the WPA labor is reported to be high.

Six miles of new road are completed or under construction; two at

Fig. 2. The natural beauty of the region has been preserved by building the new road for eastbound traffic on filled land behind the seawall, at the right. New concrete is being laid on the old road as well as the new.

Biloxi, two east of Gulfport, and two west of that city. Views of the work at Gulfport that has been completed except for the sodding are shown in Figs. 1 and 2. When the picture shown as Fig. 1 was taken, through traffic in both directions had been diverted to the lower road, which accounts for the truck moving against what seems to be the normal direction.

New concrete pavement is being laid on the old road as well as on the new. It is 24 ft. wide, 6 in. thick in the center of the slab, and thickened to 9 in. at the edges. Curbs are integral and have a sloping face. To reduce glare, the top 2 in. of the pavement is made with concrete to which emulsified carbon black has been added at the rate of 2 lb. per bag of cement. Expansion joints $\frac{3}{4}$ in. wide are built into the pavement at 40-ft. intervals. These are packed with cottonseed hulls mixed with a bituminous binder.

Construction work is being done under the general direction of R. A. Harris, chief engineer of the highway department, with J. D. Lewis as district engineer and G. W. Thompson as project engineer. The WPA is represented by T. O. Mabry, area engineer, and G. C. Lewis, project supervisor.

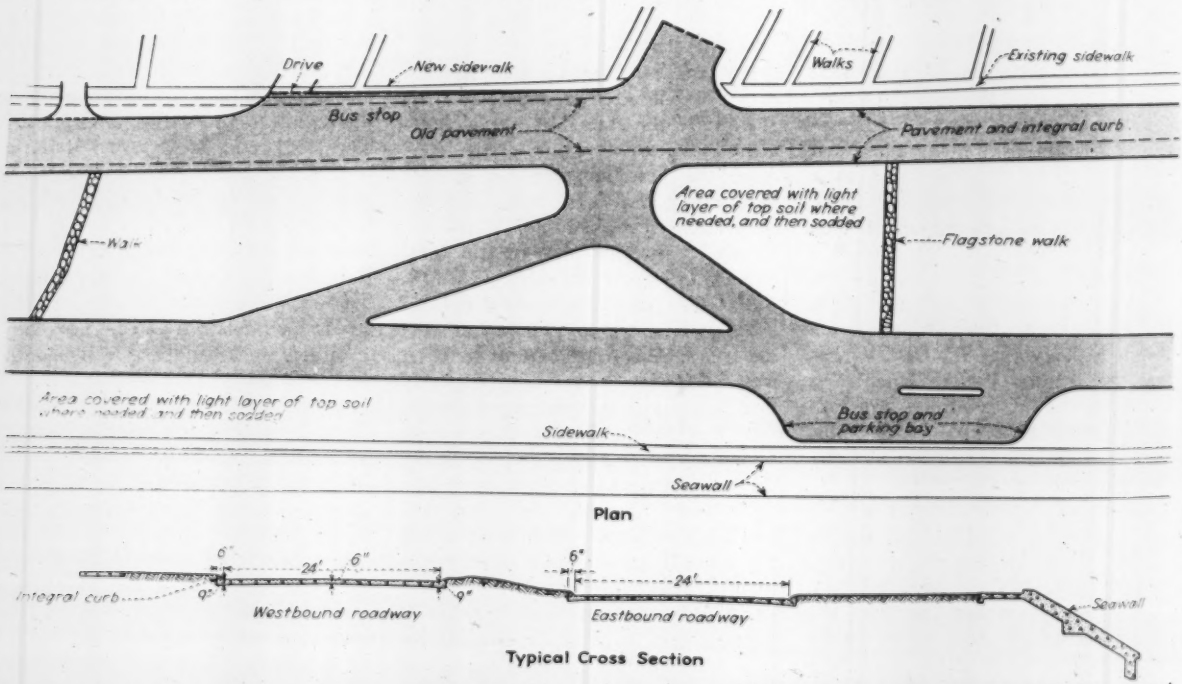


Fig. 3. The location of the new road and of the crossroads is made on the basis of a minimum change in the natural conditions. Widened areas are provided for bus stops and for parking along the seawall.

Louisiana Tries Low Heat Cement

H. L. Lehman and E. L. Erickson

Testing Engineer and Assistant Bridge Engineer
Louisiana Highway Commission, Baton Rouge

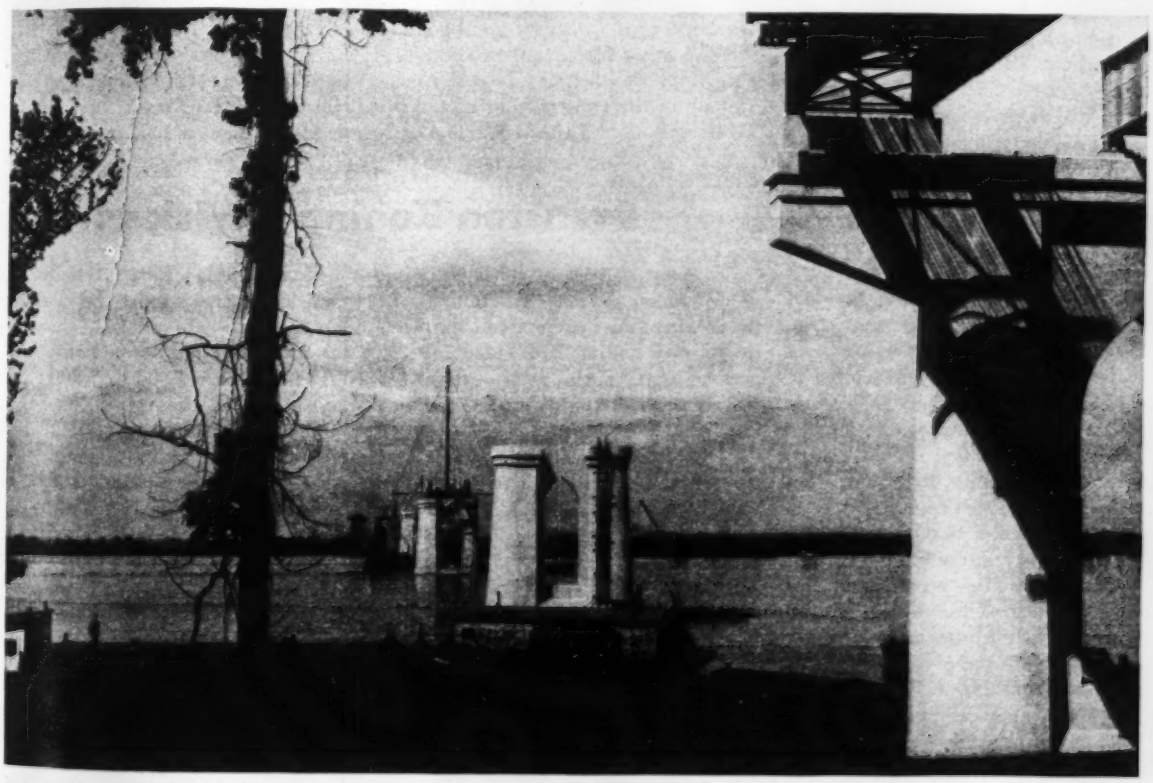
***Contents in Brief**—Cracking in the concrete of the piers and roadway slab of the Baton Rouge bridge was reduced to a minimum by the use of a modified portland cement of the low heat type manufactured to a specification that differs from that for standard portland only in that tricalcium aluminate is limited to 7 per cent and the ratio of the percentage of iron oxide to aluminum oxide to 1.50. The bridge was opened to traffic Aug. 10.*

DURING THE CONSTRUCTION of the first piers of the Mississippi River bridge at Baton Rouge, a large number of hairline cracks were in evidence upon removal of the shaft forms where a concrete containing six bags of standard portland cement per cubic yard was used. To reduce the excessive cracking, three methods of attack were considered: (1) reduce the cement content; (2) use a coarser ground standard cement to retard the rate of the heat of hydration; or (3) use a modified or low heat cement, having a low tricalcium aluminate content, thereby reducing the heat of hydration.

The first method was discarded, since it might affect the durability if not the strength of the concrete. An attempt was made to use a coarser ground standard cement, and although the heat of hydration was lowered it was not reduced sufficiently to give the desired results.

The third method of attack was then tried, that is, to reduce cracking of the surface of the concrete by modification of the chemical composition of the cement. With information obtained from the U. S. Bureau of Reclamation and the Missouri highway department through F. V. Reagel, engineer of materials, a tentative specification was drawn. The Lone Star Cement Co. of New Orleans, which was furnishing the contractor cement, signified its willingness to manufacture such a cement. Approval was secured from the Public Roads Administration, which was participating in the construction, and necessary arrangements for manufacture according to specifications were made.

A very interesting feature of the specification as drawn is that it does not affect the requirements of A.S.T.M. specification C-9-38, except in chemical composition. The low heat



Concrete of the Baton Rouge Bridge piers was rendered crackless by the use of a special modified portland cement.

cement widely used in the past few years in the construction of large dams is manufactured to a specification that permits a lower strength and requires a different chemical composition and a more rigid and detailed compound composition than the low heat cement made for the Baton Rouge bridge for which the specification is as follows:

"Portland cement low heat type has reference to portland cement meeting the requirements of the standard specification for portland cement, A.S.T.M. designation C-9-38, and shall additionally meet the following requirements:

1. The ratio of the percentage of iron oxide to the percentage of aluminum oxide shall not exceed 1.50.
2. Tricalcium aluminate ($3CaO\ AL_2O_3$) shall not be more than 7.0% when computed from the cement analysis by the method of Bogue as published in *Industrial and Engineering Chemistry*, Oct. 15, 1929."

In order to obtain some information regarding this low heat type cement as compared to the standard cement tests were conducted in the Louisiana highway commission laboratory. Four different cements, manufactured by the same company, namely, high early strength, standard portland, fine ground portland, and the special low heat cement, were tested physically and chemically for comparative purposes and for compliance with specification requirements. The program included strength tests of cylinders and beams and freezing and thawing tests of 2-in. cubes which were afterward placed in the Deval abrasion machine to determine per cent of wear without the steel balls. The results of the tests showed that the low heat type compared favorably with the other cements and showed less tendency to cracking, so that with the cooperation of the general contractor, the Kansas City Bridge Co., this cement was used in the balance of the work. The results were very gratifying.

The pours for the pier shafts varied in volume from 244 to 762 cu.yd. No change was necessary in the regular construction procedure due to use of the low heat type cement, that is, forms were not held in place for longer periods and curing was done in no different manner. Caisson forms were held in place only 12 hr. before removal and resetting. Shaft forms were held in place 24 hr. to insure satisfactory curing.

All of the piers for the main river structure have now been completed for some time, and careful inspection shows that where the modified low heat type cement has been used very little cracking is in evidence, and no crack is large enough to cause any alarm.

In the past the highway commission has experienced considerable cracking of concrete roadway slabs on steel bridge structures, so that the deck contractor on this work, W. Horace Williams Co., was also prevailed upon to use the low heat cement. Concrete used in roadway slabs contained 6 sacks of cement to the cu. yd., and it has been found that the cracking, usually experienced in this type of work, has been practically if not completely eliminated. The slab thickness is 7½ in. at the center and 6¼ in. at the curb, and the roadway has a width of 20 ft.

Results verified on roadway

This particular type of cement was specified in a roadway paving contract and used with very good results. Among other features the slower setting time was beneficial to the contractor in the construction of the lip curbs and hand finishings. The contractor on this project was awarded another paving project and after having had experience with the modified low-heat cement he requested that he be permitted to use this type in lieu of the standard portland cement originally specified.

Conclusions

The specification governing the requirements of this cement is a modification of the composition of standard cement retaining all of the minimum and maximum physical and chemical requirements specified in A.S.T.M. C-9-38. Information obtained from both laboratory tests and actual construction with this cement indicates that very encouraging results are obtained with its use. Further, it is of interest to note that: (1) it can be manufactured at the same price as standard cement; (2) its specification is not so rigid as to not be well received by the cement companies; (3) the tensile and compressive strengths compare favorably with standard cement both at early and later ages; and (4) it reduces cracking, hairline and larger, to a minimum, both in mass and light construction.

This investigation was carried on jointly by the authors and by B. P. Lyons, materials engineer, Mississippi River Bridge at Baton Rouge. For the Louisiana Highway Commission Harry B. Henderlite is chief engineer and N. E. Lant is bridge engineer.

Evanston Zoning Revisions

To keep abreast of local planning developments, the city council of Evanston, Ill., has revised completely its city zoning ordinance for the second time since 1921—when the first Evanston zoning ordinance was adopted.

The revision was made in an effort to adapt the ordinance to conditions which have changed since 1927—when the first complete revision was made—and to developments which the city council thinks may appear in the future.

The new Evanston zoning ordinance reduces by 20 per cent the amount of land zoned for commercial purposes, and by 50 per cent the area zoned for multiple dwellings or apartment houses, according to the American Soc. of Planning officials.

Single-family homes, under the new ordinance, must be built on larger lots. The revision increased the area required for a home in the "A" zone from 4,300 to 7,200 sq. ft., and in the "B" zone to 5,000 sq. ft.

The new ordinance also creates a new district in which two-family and row houses may be constructed, and requires apartment buildings, row houses and theaters to provide off-street parking facilities—one parking space for every two dwelling units, or for every 10 theater seats.

It is said that other cities besides Evanston are bringing their zoning ordinances up to date, although few contemplate such complete revisions. These cities include New York, Los Angeles, Portland, Ore., and Des Moines.

Something New In Bulkhead Anchorages

George B. Sowers
Consulting Engineer, Cleveland

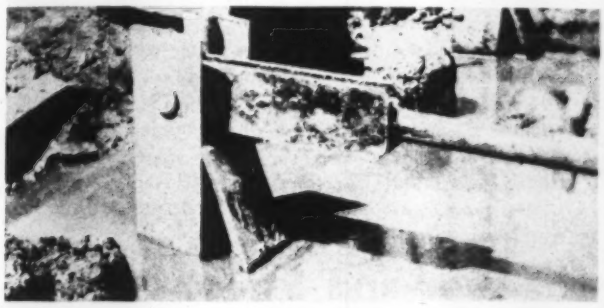
***Contents in Brief**—Steel sheetpile bulkhead along rectified Cuyahoga River channel is anchored by pile A-frames where lack of space or sliding ground made ordinary deadman anchorage impracticable. The back or tension leg of the A-frame is a concrete bulb pile, and in test developed more than 100 tons pulling resistance.*

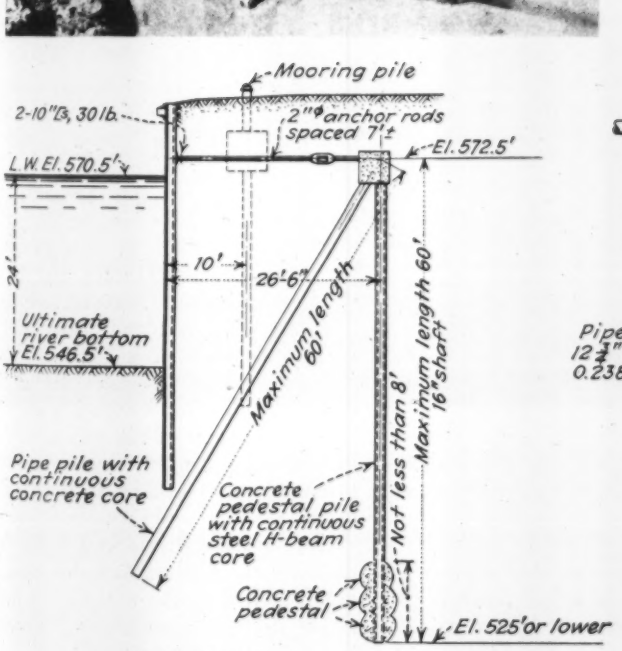
ALONG SOME SECTIONS of the new channel of the Cuyahoga River in Cleveland industrial buildings were so near the bulkhead that a deadman type of bulkhead anchorage could not be used. At other points the bulkhead must support high surcharges, and the river bank tends to creep or slide outward; here the bulkhead must be anchored to the firm soil below the river bottom. A new form of A-frame anchorage consisting of steel and concrete piles is being used successfully under these conditions.

Nearly 1,400 lineal ft. of this bulkhead with A-frame anchorage is being built, about half of it completed.

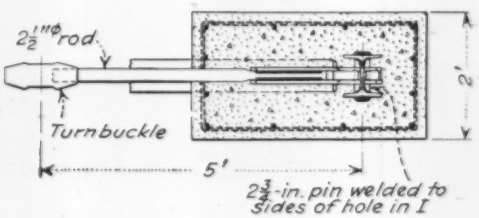
As shown by the drawing, below, the anchorage A-frame consists of a front batter pile acting as compression leg and a vertical concrete bulb pile forming the tension leg. Uplift tests on several of the bulb piles have been made up to the elastic limit of the steel H-beam core without lifting; the bulbs in these cases were in soft plastic clay at a depth of about 50 ft. below river level. Pulling loads in excess of 100 tons were applied through a deep steel beam attached to the H-beam core and resting on hydraulic jacks supported by the tension piles of adjacent anchorage bents, 6 to 7 ft. away.

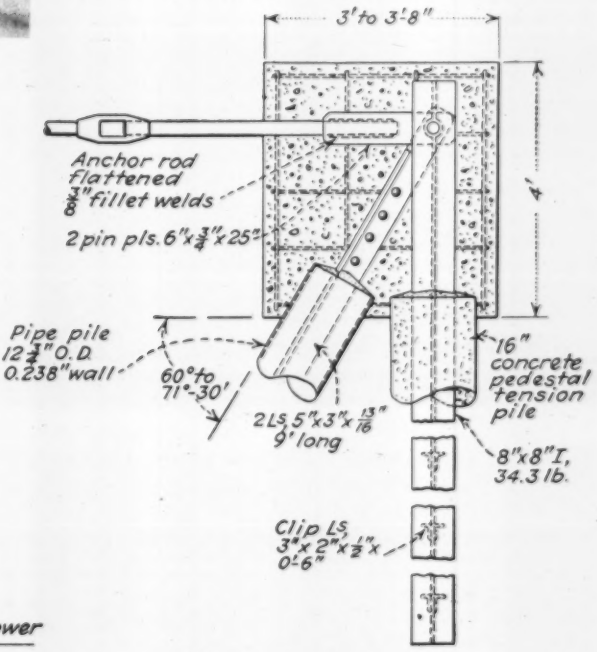
The bulkhead is of MZ-32 and 38





Cross-Section of Bulkhead




3' to 3'-8"
Anchor rod flattened
⅝" fillet welds
2 pin pls. 6"x¾"x25"
4'
Pipe pile 12¾" O.D. 0.238" wall
60° to 71°-30'
2 Ls 5"x3"x 13/16" 9' long
16" concrete pedestal tension pile
8"x8" I, 34.3 lb.
Clip Ls 3"x 2"x ½"x 0'-6"

Head of A-Frame

Steel pipe driven as batter pile and filled with concrete forms the front or compression leg of the A-frame while a concrete bulb pile embedded H-beam forms the tension leg. The two legs are connected by a pin to which the bulkhead anchor rod is attached.

steel sheetpiles 48 to 60 ft. long, driven along the sides of the navigation channel, which is to be dredged ultimately to 24-ft. depth. The tops of the sheetpiles are 7 to 9 ft. above river level, depending on location. A waler of two 10-in. 30-lb. channels is bolted to the back of the bulkhead 2 ft. above low water as a connection for the anchor rods. The front of the bulkhead carries a longitudinal rubbing timber near the top and vertical 12x12 rubbing timbers at 14-ft. intervals. The entire space behind the bulkhead is backfilled. Mooring piles independent of the bulkhead or anchorage are driven 10 ft. back of the face where required.

Anchor rods engaging the double-channel waler at 3½ to 7 ft. spacing extend back to the A-frames, each of which takes the pull of one rod and transfers it to pressure and uplift on the undisturbed soil 50 to 60 ft. below water level.

How the legs were installed

The compression leg of the A-frame, carrying a load of 44 to 56 tons, depending on the slope of the batter pile, is a steel pipe 13 to 16 in. diameter, maximum length 60 ft., driven with closed lower end and filled with concrete after driving. Depth and driving resistance were determined by test piles.

The tension leg is constructed by driving a 16-in. forming tube or shaft to the desired depth, with lower end temporarily closed, to a resistance representing about 50 tons load capacity. The pipe is then partly filled with concrete, pulled back 2 or 3 ft., and the concrete driven out by a rammer fitting the pipe closely. Filling and ramming is repeated until not less than 15 cu.ft. of concrete has been forced outside the 16-in. shaft. Immediately thereafter the steel H-beam core is set in the pipe and forced down through the concrete until its lower end reaches the original level of the ends of the pipe, and the remaining space in the pipe is then filled with concrete. The specifications permitted the contractor to pull the pipe if he did so without disturbing the concrete or the steel core; the pipe was withdrawn in all cases.

The batter piles of the different A-frame bents were all driven first, using a steam crane with leads leaning out at the top, so that the pile actually was driven under the frame. Then the tension pile was driven and concreted, and finally the pin-connection forming the head of the A-frame was made and the entire head encased in a block of concrete. The method of forming the head connection is indicated in the drawing. A completed head before concrete encasement is also shown as a part of this same drawing.

Uplift resistance is tremendous

The character of the soil holding the bulb piles may be judged from the fact that 12¾-in. pipes can be driven to depths of 80 to 90 ft. below water level before developing enough resistance to carry a load of 70 tons without settlement. Yet under 100-ton jack lift maintained for 48 hours the bulb piles showed no movement beyond an initial ¼-in. lift, and subsequent increase of the pull to 160 tons produced a maximum lift of only 0.03 ft.

This rigid anchorage to undisturbed soil strata at considerable depth is especially valuable along the east bank of the river at Collision Bend. Here the hillside sloping up to the yard tracks of the Union Terminal has been sliding for a number of years, probably because of the load of two 20-ft. retaining walls and the progressive washing away of the foot of the slope, which continues unprotected down to the bottom of the river. The entire river bank for a height of perhaps 100 ft. has been sliding, and there was little hope of holding the new bulkhead by anchorage back to the hillside itself. Transfer of the anchorage to strata 20 or 30 ft. below river bottom is confidently expected to hold the bank against further movement.

The design of the A-frame anchorage was developed by J. H. Thornley, president of the Western Foundation Co., and the writer, to meet the particular conditions here encountered. The Western Foundation Co. was contractor for the construction of the bulkhead and A-frames at Cut 9 of the river improvement and for the anchorage A-frames of the bulkhead adjacent to Center St. bridge.

While the basic idea of A-frame construction for anchorage purposes is old, the construction shown is believed to be new and of wide application to conditions similar to those here encountered. The cost of anchorage and bulkhead in the section so far built has ranged from $120 to $180 per lin. ft., depending on the weight of sheetpiles and spacing of anchors used.

Oak Park Sewer and Street Cleaning

SYSTEMATIC CLEANING of all sewers is the policy of the street department at Oak Park, Ill., the combined storm-water and sanitary sewer system being maintained by this department, which operates a sewer cleaning machine, as noted in the 1939 annual report of the Department of Public Works. Catchbasins are cleaned with an eductor mounted on the frame of a motor truck.

From some 72,000 ft. of sewer cleaned, 322 cu.yd. of dirt were removed at a cost of 5.44c. per cubic yard. From 2,100 catchbasins, 1,395 cu.yd. of dirt were removed at an average cost of $1.243 per individual catchbasin.

Many complaints were received by the department as to stoppage of house drains and catchbasin connections. In 101 cases the street department had to rod and clean sewer stubs, and in 50 per cent of these cases the trouble was due to roots of trees, principally poplar trees.

Paved streets were cleaned every other day in the business districts, and every ten days (except in winter) in the residential districts. About 4,427 gutter-miles were cleaned by a motor pick-up sweeper and 2,182 miles by hand, at an average cost per gutter-mile of $1.0219 and $2.0304, respectively. Removal of 8,944 cu.yd. of dirt and leaves cost 77.39c. per yd.

Snow is removed from the 200 miles of sidewalks by steel V-plows drawn by horses of the garbage collection service, first attention being given to routes leading to transportation stations and schools. Boulevards, through streets and business districts are cleared first, the snow being pushed to the curb. Then the residential streets are plowed. Snow is removed by motor trucks and deposited on vacant lots. For 1939, the total cost (including $600 for two plows) was $6,991 for 888 loads removed, or $7.87 per load.

Concrete Formula Based on 6,000 Tests

N. M. Finkbiner and G. W. Harra

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Oregon State Highway Commission, Salem, Ore.

***Contents in Brief**—Predicting 28-day strength of concrete from results of tests of 7 day cylinders is common practice. Formulas are necessarily empirical and the best ones are those that average the largest number of tests. The Oregon highway department has used 6000 cylinders to develop the formula $S_{28} = 1.51\ S_7 + 49$. The most widely used previous formula is that of Slater, $S_{28} = S_7 + 30\sqrt{S_7}$*

SEVERAL FORMULAS for the prediction of compressive strength of concrete from early age test results have been evolved and are in general use. To these is now added one developed by the materials department of the Oregon State Highway Commission, which is based on an analysis of compressive test results of more than six thousand 6 x 12-in. control cylinders made from concrete used in pavements, sidewalks, bridges, culverts and other structures during the period from 1935 to 1939. These cylinder were the regular control specimens, and were cast in the field by the engineer or inspector assigned to the particular job. The test specimens were cured for the first four or five days under field conditions, and were then transferred to the laboratory where the curing was continued in a moist closet at a temperature of 70 deg. F. The greatest number of specimens were broken at ages of seven and twenty-eight days, with sufficient numbers at fourteen, twenty-one, and sixty days to warrant their consideration in the plotting of the strength prediction curves.

The aggregates used were natural sands and gravels, as well as manufactured sands and quarry rock; and four different brands of standard portland cement were utilized, for which chemical analyses and average strengths are given in Table 1. Strength differences as shown are probably due entirely to differences in physical fineness and chemical composition. Cements A, B, and C show a compressive strength increase from seven to twenty-eight days practically coincident with the average strength increase of the concrete from seven to twenty-eight days.

Graphic presentation of compressive strength prediction curves, representing concrete using each of the four cements, is made in Fig. 1, which also includes a summation of these curves in the form of a set of generalized curves. Nominal values (Table 2) were selected at twenty-eight days and are used in plotting these strength curves. In computing values for the generalized curves the values of compressive test results of concrete from each brand of cement were weighted as to the number of test specimens in each strength range. Fig. 2 is a plotted straight line equation representing the general relationship between strength at seven and twenty-eight days. The expression is $S_{28} = 1.51 \times S_7 + 49$ lb.

Work done by other investigators, using entirely different materials and mixes, shows results similar to this analysis. Slater's equation (*Proceedings*, American Concrete Institute,

TABLE 1—DATA ON CEMENTS USED

	Cement A	Cement B	Cement C	Cement D
Ten. Str., 7 days, lb. per sq. in.	371	390	360	364
Ten. Str., 28 days, lb. per sq. in.	441	452	427	456
Comp. Str., 7 days, lb. per sq. in.	3094	3204	2968	3176
Comp. Str., 28 days, lb. per sq. in.	4724	4714	4489	5577
Autoclave Test:				
Expansion, per cent	.042		.133	
Contraction, per cent		.028		.028
Insoluble Residue, per cent	.50	.37	.36	.47
Oxides, per cent:				
SO_3	1.80	1.88	1.73	1.71
Fe_2O_3	3.41	4.66	2.29	1.89
Al_2O_3	5.94	5.53	6.99	3.63
CaO	63.77	64.76	65.21	65.63
SiO_2	21.23	21.64	21.36	25.17
MgO	2.25	2.25	2.00	1.60
Compounds, per cent:*				
$CaSO_4$	3.05	3.20	2.94	3.00
C_4AF	12.12	14.17	7.01	5.15
C_3A	9.83	6.56	14.60	6.39
C_2S	30.16	20.92	25.21	39.66
C_3S	43.28	53.23	47.85	43.77
MgO	2.25	2.25	2.00	1.60

* The approximate average compound composition of standard footload cement is often estimated to be as follows: C_3S, 50 per cent; C_2S, 20 per cent; C_3A, 13 per cent; and C_4AF, 12 per cent.

TABLE 2—CONCRETE CYLINDER STRENGTHS

Cement	Compressive Strength Lbs. per Sq. In. 7 Days	28 Days	60 Days
A	876	1500	2055
B	1010	1500	2013
C	1100	1500	1891
D	827	1500	2081
A	1230	2000	2532
B	1328	2000	2508
C	1415	2000	2394
D	1156	2000	2523
A	1585	2500	3010
B	1647	2500	3003
C	1729	2500	2897
D	1485	2500	2965
A	1940	3000	3487
B	1966	3000	3498
C	2043	3000	3406
D	1815	3000	3407
A	2294	3500	3964
B	2284	3500	3993
C	2358	3500	3904
D	2144	3500	3849
A	2649	4000	4441
B	2603	4000	4488
C	2672	4000	4407
D	2473	4000	4291
A	3003	4500	4919
B	2921	4500	4983
C	2987	4500	4911
D	2803	4500	4733
A	3358	5000	5396
B	3240	5000	5478
C	3301	5000	5414
D	3132	5000	5175

In this table nominal values are taken at 28 days. The actual 28 day strengths are within 250 pounds per square inch above or below the selected strength of each class of concrete with each kind of cement. The 7 and 60 day values are derived from the average strengths of cylinders cast from the same concrete and at the same time as those broken at 28 days.

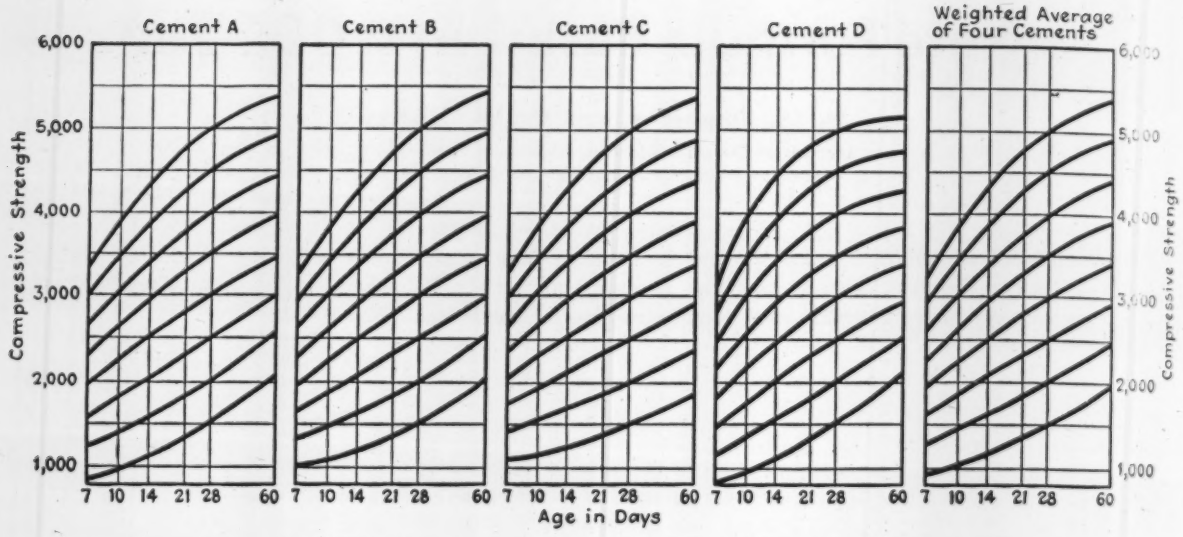


Fig. 1. Relationship between 7- and 28-day compressive strength of concrete cylinders made with four different brands of standard portland cement, and (at the right) curves for the weighted average of the results with the four cements.

1926) $S_{28} = S_7 + 30\sqrt{S_7}$, gives a slightly higher strength prediction for concrete of less than 4500 lb. per sq. in. at twenty-eight days. Data given by Gilkey (*Proceedings*, American Concrete Institute, 1928) show the expected strength at twenty-eight days to be 1.5 that obtained at the age of seven days. These results are based on tests of concrete made several years previous to those considered in this article. It would seem that, in general, changes in cement strength and composition during the last few years have had less effect upon the compressive strength of concrete than might be expected. Although different cements will show slightly different compressive strength changes relative to test ages, this difference is not sufficiently great to affect materially the average values as expressed in the curves shown at the right in Fig. 1.

Concerning the accuracy of prediction of twenty-eight day compressive strengths of concrete by the formula $S_{28} = 1.51 \times S_7 + 49$, due consideration must be given to the number of seven-day test specimens. Results of one or two seven-day cylinder breaks are not sufficient. By using the average strength of several seven-day test cylinders, however, it is reasonable to estimate the twenty-eight day strength, as predicted by the formula, to be within 200 lb. per sq. in. of the true twenty-eight day strength of the concrete.

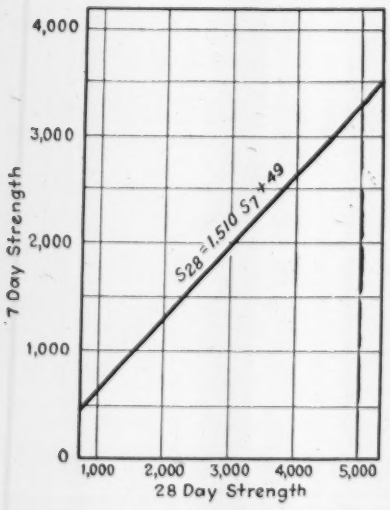


Fig. 2. Prediction curve for 28-day strength of concrete based on results from 6000 test specimens.

Indianapolis Sewage Plant Needs Enlargement

CONSIDERATION must be given to the probable necessity of expansion of the sewage works at Indianapolis, Ind., within the next two years, if the city continues to grow in population and industry. This is the situation as stated in the 1939 report of the Board of Public Works and Sanitation, which adds that it is doubtful whether increase in operating efficiency can keep up with the increased load upon the present plant.

The activated sludge treatment was in use for 346 days. Sewage was stronger than in 1938, with consequent longer detention period in the aerators and greater amount of air used. Although the quantity treated was less in 1939, the degree of purification was higher, as measured by pounds of B.O.D. removed. There is not sufficient plant capacity to treat all the sewage by the activated sludge process, but in spite of this the White River was maintained in reasonable condition throughout the year. Digested sludge disposed of amounted to 35,050 cu.yd., or 35 per cent more than the previous high record. Practically all of it went as fertilizer to market gardeners.

Cost of operation of the plant was $8.81 per million gallons of sewage treated, of which 78c. was for grit chamber and incinerators, $3.07 for clarification and pumping, $4.26 for secondary treatment, and 31c. for sludge disposal.

Garbage reduction of 29,348 tons was 7 per cent higher than in 1938, which in turn was 12 per cent higher than in 1937, indicating a gradual yearly increase. The cost of operation for the garbage reduction plant averaged $3.55 per ton. This plant sold 2,657 tons of fertilizer, 1,027 tons of feed, and 1,664,590 lb. of grease.

From Field and Office

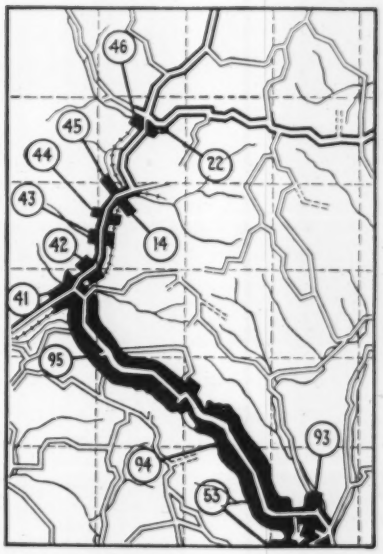
Working problems and time-saving methods for engineers and contractors

Flood Data for Design

During the extreme high water experienced in Ohio in the spring of 1940, higher in local areas than the 1937 flood, actual field data were obtained for each affected section of the state highway system. These data included the length and maximum depth of each inundated section, the length and type of each wash area, and the length and location of each landslide. They were superimposed on the individual county maps of the state and reproduced by photostats for use of road planners and designers.

Part of Bern Township of Athens County is shown here to illustrate the method used and data made available. Areas 41 to 46 inclusive are on alternate U.S. Highway 50. It will be noted that stretches up to 0.4 mile were a maximum of 5 ft. under water. However, across the rest of the county only small areas of the road were under water, so perhaps raising the road to meet this flood condition is justified. Areas 93, 94, and 95 are on a road only slightly improved. Major changes necessary to make this an all-season road are indicated by the fact that it is almost all under 10 to 15 ft. of water. At least the designers will know the problem.

The figure 14 indicates a wash. In the tabulation the length is given, then the type. Numbers 22 and 53 indicate a landslide which is tabularly described by length and location, above or below the roadway.



Flood information on an Ohio township

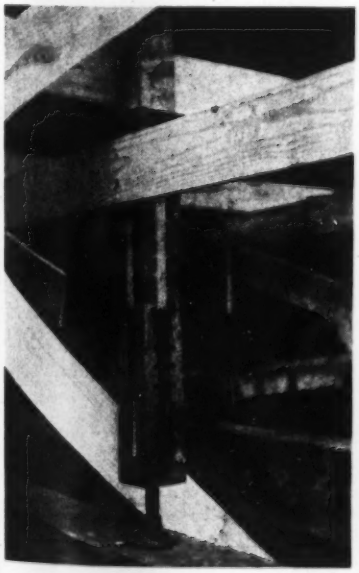
Flood (41) 0.4 miles long by 5 feet deep; (42) 0.1 mi. by 2 ft.; (43) 0.3 mi. by 4 ft.; (44) 0.2 mi. by 3 ft.; (45) 0.2 mi. by 3 ft.; (46) 0.2 mi. by 2 ft.; 93, 0.1 mi. by 10 ft.; (94) 1.8 mi. by 10 ft.; (95) 1.9 mi. by 15 ft. Wash (14) 300 ft. below. Landside at (22) 50 ft. below; at (53) 200 ft. below.

Adjustable Shore

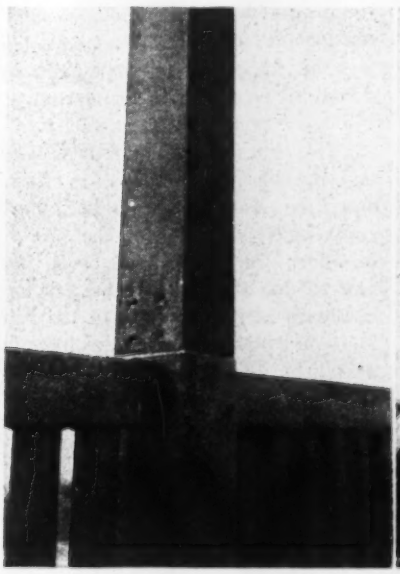
Adjustable shore used by Poirier & McLane Corp. on double deck section of the recently opened East River Drive in New York. A 4 x 4 within 2 ft. of the required length can be used, saving sawing of lumber. Screw adjustment bearing, in swivel washer, eliminates wedges. A spud wrench on the nut gives accurate level under full load or loosens shore for stripping without difficulty.

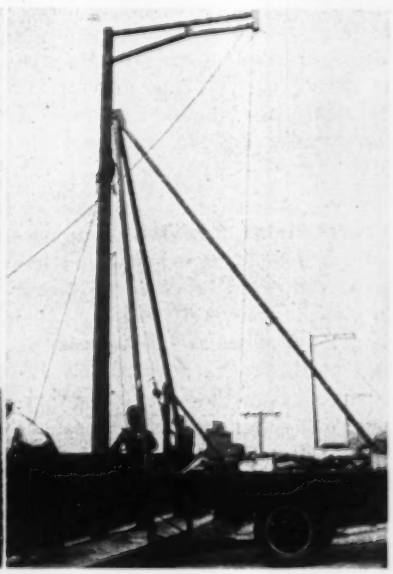
Welded Rails, Light Post

Lighting standards and railing of welded hollow steel tube construction are features of Cleveland's new Main Avenue Bridge. The upper rail is a 5x4-in. section, the lower rail a 4x4-in., while the spindles consist of 2½-in. square tubing spaced about 5½ in. on centers. The railing panels were shop fabricated in 6 ft. lengths, designed to drop in between the rail posts to which they are attached by welded lugs. The light standards rest on the railing posts to which they are attached by plug welds, as shown in one of the accompanying illustrations. Extending about 25 ft. above the roadway, the lighting standards are provided with brackets that reach out about 8 ft. over the roadway. Completely shop-fabricated, they were speedily erected by the simple truck-mounted derrick illustrated.



Adjustable shore with screw adjustment bearing that eliminates wedges.





Plug weld connection (left) of lighting standard to railing post and (right) erection of the standards with a pipe derrick on a truck.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

SLUDGE DRYING — Advantages cited to dry digested sludge in glass-covered structures concern principally the time of drying required, confinement of possible odors and keeping rain off the sludge. It has been claimed that the drying time can be reduced from 25 to 50 per cent and consequently reduced the sludge bed area of glass enclosures to as much as one-half of the open beds. Wittwer (*Annual Report*, Rahway Valley (N.J.) Joint Meeting, 1939) states that there has been an unusual opportunity at the Rahway plant for comparing the relative merits of open and glass-covered drying beds during the last 2½ years, when a total of 168 dryings was made. With a uniform depth of wet sludge application of about 12 in. on both types of beds and disregarding unequal weather conditions or final percentage moisture in the sludge, the drying time on open beds was materially shorter during 10 months of the year, with only slight differences in favor of the closed beds during December and January.

The conclusion is reached that "the open and covered beds are approximately equal in performance." Since the sludge is well digested and has no objectionable odors no advantage is gained in this respect. Reports published from different sections of the country are not in agreement with Wittwer's observations.

MEAT PACKING WASTE—A considerable amount of experimentation has been conducted on the treatment of meat packing wastes. One of the difficulties in this industry is that conditions vary greatly in different plants and localities. The character of the waste varies and depends a great deal on the size of the plant and the manner it is handled. Until recently biological methods were not favored because of the high initial cost and objectionable odors. Solids in packing house wastes are largely proteins and if treated fresh as much as 90 per cent can be coagulated with chemicals

Childress (*Proceedings*, 21st Texas Water and Sewage Short School, 1939) discusses three different types of treatment, one of which includes paunch manures often removed before treatment. In the Tovera packing plant system the solids reach sometimes as high a figure as 12,000 ppm. The treatment plant uses ferric chloride as a coagulant and consists essentially of screens, flash mixer, flocculator, clarifier and two-stage digestor. The effluent is used to irrigate a part of a 160-acre ranch and has an average B.O.D. of 200 ppm. About 30,000 cu. ft. of gas produced every 24 hours is used under the company steam boilers. The sludge is placed on natural drying beds where it remains for 20 to 50 days. The cost of the plant was about $40,000 giving evidence of a serious attempt to treat the waste, although after treatment it is still as strong as an average domestic sewage. This appears to be one of the most complete treatment processes where all waste is handled and treated separately.

ECONOMICS OF FILTERS — Circular filter beds appear to reach a limit in size so far as economical construction and operation are concerned. Comparative experiments made by Wilson and Hamlin in South Africa (*Jour. and Proc.*, Inst. Sewage Purif., Part I, 39, 1939) show that in the case of 6-ft.-deep open filters the cost per unit volume of sewage treated per day decreases as the diameter of the bed increases, but that little advantage is gained by units of a larger size than 100 ft. in diameter, unless the size of the treatment works is very large.

In covered beds 6 ft. deep the most economical unit is from 80 to 100 ft. in diameter, depending upon the type of roof, provided it will treat more than 1½ to 2 times the quantity of sewage treated on an open bed. Where beds are 12 ft. deep, nothing is gained by having units larger than 100-ft. diameter. The cost of a 12-ft. open filter is about three-fourths that of a closed filter. These costs do not take into consideration provision for artificial ventilation or royalties.

Covering of the filter may be justified for conserving of heat in winter, because cold weather may retard action sufficiently to lower purification to half of the summer. Covering appears to give some measure of odor control, but has no effect on fly control, except that the flies are more confined. These advantages appear to warrant close investigation whenever a new installation is contemplated and cooling, odor and fly nuisances are factors.

SLUDGE FERTILIZER — The question of destruction versus use of sewage sludge is coming again more and more into the foreground. There are on record a number of instances where the value of sludge as a soil builder and for fertility definitely is shown, while in other instances the sludge appeared to do more harm than good. It is possible that wrong use is responsible in the latter cases rather than the inherent quality of the sludge. Temple (*The Surveyor*, Dec. 15, 1939) points out that the utilization of vegetable and animal wastes in crop production involves two definite steps: (1) the preparation of humus and its incorporation into the soil; and (2) the slow oxidation of the product, accompanied by the production of available nitrogen. To this may be added the various minor elements necessary in growth and traces of growth-stimulating substances.

The two stages mentioned are brought about by micro-organisms and if humus production occurs in the soil itself it may interfere with the development of the crop. This means that danger from well-digested sludge is practically non-existent but may be caused by raw sludge. Proper composting of the sludge alone or with garbage produces a valuable product. Such a method can be made practically fool-proof in operation and does not call for a great expenditure. Such products cannot be judged like artificial fertilizers by their chemical contents alone, but by their effect on the crop. In other words the fertility value is greater than the fertilizing value. No quick results should be expected.

CHALLENGE TO INDUSTRY'S PATRIOTISM

Calls for Plain Speaking

IT is a pity that the greatest national defense effort in American history had to be made during a presidential election campaign. For a modern defense effort involves an intensely practical industrial project, while an election campaign involves an intensely emotional political propaganda. And those two don't mix.

That, as I see it, is the chief reason for the welter of claims and denials, charges and counter-charges that have been getting in the way of contracts for planes, tanks, guns and all the rest of the armament for which the American people are so nervously peering down the road.

We are told that the managers of industry, smarting and suspicious under the repeated attacks of government officials for some years back, have been reluctant to assume the abnormal risks of defense contracts without commensurate safeguards, and that the politicians who must authorize those safeguards have been reluctant to do anything that might be construed as letting down the bars for unscrupulous business men to exploit the national emergency. For the one, the business risks of full speed ahead have been too great; for the other, the political risks of full speed ahead have been too great. So we don't go full speed ahead.

This is not written to increase that clamor of recrimination on either side. On the contrary, it is an appeal for some decent and thoughtful consideration on the part of all concerned—consideration for the urgent needs of the nation, for the problems and responsibilities of both the politicians and the industrialists, for the elementary principles of prudent business management, and for the good opinion of the man on the street. He is neither a politician nor an industrial executive. But his hide and his pocketbook are at stake in the national defense program—and he knows it. He has a right to the low-down on what is going on. And if he is left in ignorance or deliberately deceived, for the sake of either political or business whoopee, the payoff will be mighty poisonous political medicine for the politicians and equally poisonous business medicine for the business men who may be responsible.

* * *

The plain stark fact, to be faced squarely by us all, is that the national defense program is an emergency project—a desperately urgent emergency project.

As in every emergency that confronts a democracy, we are harassed by a confusion of counsel. As always, some of the confusion arises from honest but conflicting judgments, some of it from ignorance or muddy thinking. But, unhappily, much of it reflects the deliberate purpose of self-seekers to fish in troubled waters—to capitalize the conjunction of a national emergency and a political campaign to boost their own interests. Already the charge that American business men are unpatriotic and interested only in profit has been put out as a smokescreen to cover up deficiencies for which business men are in no way responsible.

Now the man on the street finds it hard to see through this maze of excited contradiction. Not because he isn't smart—the average American can think straight enough *when he has the facts*. But in this case the facts are obscure and complicated—they have to do with matters that are strange to him. And to make it worse, at the height of his confusion, raucous voices constantly assail his ear with "simple" explanations of it all. But, as so often happens, most of these "simple" explanations make the matter a lot simpler than it really is.

* * *

Consider, for example, the cry that "industry refuses to get busy on national defense until its profits are guaranteed". Very clear and simple, to be sure; but also very false. The charge that American capital is "on strike" in the hour of national need. As silly as it is simple. The assertion that our manufacturers "won't even talk with a government anxious to place orders with them, without large financial concessions", and that "American corporate industry refuses to expand its resources for defense until it receives immunity from proper taxation". The resounding demand that we "conscript wealth as well as men"—whatever that may mean.

Particularly political has been the attack on the aircraft industry. It has been made to appear that aircraft manufacturers were instituting a sit-down strike because, in their greed for profits, they demanded more than 8%. Actually the 8% was not a net profit at all and the only concern of the manufacturers was to fight against incurring losses under the 8% limitation. And army and navy officers have sustained the aircraft manufacturers' viewpoint.

The air is full of explanations which, however simple they may sound, do not explain. And in most cases, I am convinced, the purpose of those who offer them is not to explain but to inflame. Those who try honestly to explain these issues from either side, find it impossible to do the job in such ringing phrases.

As I have said, our country has been caught short. As

a result, there are many reasons for the confusion and controversy. The plain fact is that we can produce our war equipment by only two means: (1) by converting the industries of peace into the industries of war, so far as that is possible; and (2) by building from scratch the new facilities we need to supplement them. In other words, we must create—with desperate haste—a new industry in America—an armament industry.

Right there is the crux of the problem that now confronts the industrialist sincerely trying to equip himself for his part in national defense. For this new armament industry is not the ordinary business risk against which he has learned to weigh the interests of his employees and his stockholders. It does not deal with familiar products and processes. It is not continuous—at least it has not been heretofore in this country—and it may fold up as suddenly as it has opened. It cannot hope to serve thousands of potential customers: it has but one sure customer—the United States Government—and wielding the sovereign power that customer can do just about as it pleases with respect to its needs and demands. Which means that not even this one is a *sure* customer.

* * *

No more unfair or deceptive charge ever has been leveled against American industry and American business men than the accusation of being unwilling to take the normal business risks of the defense program. The risks they are trying to minimize—they cannot possibly avoid them all—are very special and extraordinary risks indeed. So clearly is that true, that I doubt very much whether such questions and charges ever would have risen were it not for the fact we are engaged in a political campaign.

Already some of industry's great units have gone ahead with the building of new facilities, the purchase of special materials, and the actual production of armament in the face of all risks, gambling that their government eventually would work out some reasonable plan to protect them against excessive loss. Others, doubtless will follow suit.

But many other companies, for one reason or another, are not in position to do that. So before they begin to expand their facilities to handle defense contracts, they have asked their *only potential customer for those new facilities* to guarantee them—*not* excessive prices, *not* exorbitant profits, *not* immunity from taxation, as we are being told, but simply against the excessive losses that may result from very extraordinary conditions.

* * *

As this is written, it looks as though the legislation and the rulings necessary to accomplish this purpose soon will be forthcoming. Thoughtful and responsible officials of the government understand the situation and what is needed. But, unfortunately, their understanding and action will not quiet the professional business-baiters. So long as those gentlemen have their own interests to serve, so long as political excitement makes it easy to whip up public demand for a scapegoat to atone for disappointing progress with the defense program—just so long will the business-baiters find a receptive audience for their criticisms.

All of which suggests that business men must carry at this time a double responsibility, in addition to their obvious obligation to do the very best job they know how on their individual parts of the defense program.

The first of these added responsibilities is, of course, to avoid any possible basis for the charge that industry is exploiting the defense program in behalf of excessive profit, unfair treatment of labor or any other unworthy self-interest. The second is to see that the man in the street knows and understands all that I have tried to set down in the foregoing.

For the man in the street is deeply involved in all this. He is "in the street" only to the political orators. To the rest of us, he is the man in the factory, the man on the truck, and the man behind the orders that industry fills. In short, he makes up this living American industry on whom the politician's charges spatter. As an employee he has a stake in the solvency, the security, and the reputation of the very plants at which criticism may be directed. Knowing the facts, he can answer the critics so far as his own plant is concerned and can see how the same kinds of facts apply to all industry. If he is a customer, suffering inconvenience as a result of the plant's service to national defense, a knowledge of the facts behind the plant's problems will help to make him a defender rather than a critic of responsible business management. If he is a neighbor in the community, the facts will equip him to be an interpreter of industry's problems to the people of the home town.

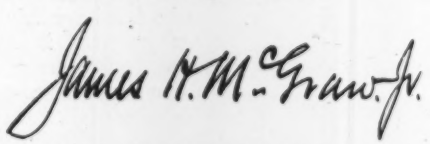
* * *

In this national defense effort, business enters into a new partnership with government, but, more importantly, into a deeper partnership with the American people. It is more than ever essential that it take all of the American people into its confidence, beginning with the people in its plants and going out through the ranks of its customers and its community neighbors to show them that they have a common interest in seeing that the task of national defense is undertaken in the American way.

As we all know, there are in this country some people who would like nothing better than to see American industry fail in this supreme test of service to the nation. They will watch with jealous eyes every move of every company that is engaged on a defense job. They will disparage its achievements, exaggerate its shortcomings, and distort its motives. For they would like to make over American industry to their own pattern, and they'll never have a better chance to get started with it than has been opened up by the national emergency. Or so it looks to them.

So, great as are the business hazards of the defense program for the individual business man, even greater hazards are involved for American industry as a whole. But, knowing the temper of American industrial leadership as I do, I am confident that it will handle its defense assignment with credit to itself and with great advantage to the nation that it serves—whether in war or in peace.

To help in that supreme test is the opportunity and the privilege of the McGraw-Hill organization.



President, McGraw-Hill Publishing Company, Inc.

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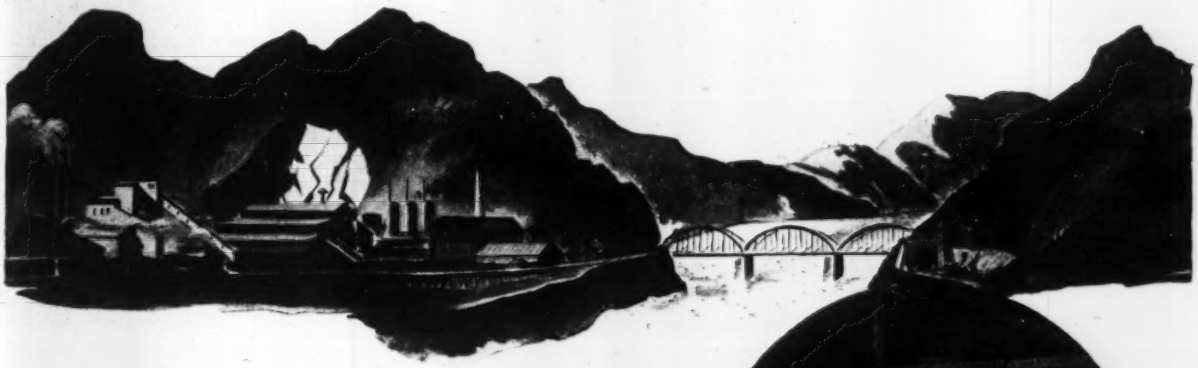
America speeds up



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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

WATER PIPE LINES, CALIFORNIA

OWNER: Metropolitan Water District, Los Angeles, Calif.; F. E. Weymouth, engineer.

PROJECT: Construction of approximately 16 miles of water pipe lines and appurtenant works for the Burbank-Santa Monica feeder of the Colorado River Aqueduct distribution system. Work to be divided in three schedules. Schedule 31 from Sta. 3,735 + 28 to 4,042 + 30 to be constructed of precast concrete pipe; Schedule 32, Sta. 4,079 + 59 to 4,333 + 65, to be of cast iron with spun mortar lining; and Schedule 33, from Sta. 4,333 + 65 to 4,620 + 53, also of cast iron with spun mortar lining. An alternate of welded steel pipe was offered, but low bids were as shown above.

CONDITIONS: All work must be completed by March 31, 1941. Schedule 31 must be carried on at same time allotted by city for construction of utilities in Cahuenga and Barham Blvds. Owner to furnish cement, sealing compound, whitewash, paint, joint rings and gaskets, reinforcing bars, wire mesh, structural steel, valves and metalwork for structures, flanged pipe and fittings, cast-iron electrolysis test boxes, venturi meters, and 30-in. concrete wasteway pipe. Wages are: skilled, $1.25 per hr.; semi-skilled, $1.00; and common, 62½c. per hr. Highway and railroad transportation facilities available.

BIDS: On the type of construction on which the award was made, two bids were opened June 25, 1940 on Schedule 31, $514,940 and $523,427. On Schedule 32, only one bidder, Artukovich Bros., Hynes, Calif., $394,475. On Schedule 33, three bids were received, ranging from the contract low of $366,332 to $448,458.

LIST OF BIDDERS:

Schedule 31:

1. United Conc. Pipe Corp., Los Angeles, Calif. (contract) $514,940
2. American Conc. and Steel Pipe Co., Los Angeles, Calif. 523,427

Schedule 32:

1. Artukovich Bros., Hynes, Calif. (contract) $394,475

Schedule 33:

1. Artukovich Bros., Hynes, Calif. (contract) $366,332
2. United Conc. Pipe Corp., Los Angeles, Calif. 448,089
3. Warren Southwest Inc., Los Angeles, Calif. 448,458

Schedule 31—Precast concrete pipe
Sta. 3735 + 27.7 to 4042 + 30

Item	Quan.	Unit Prices (1)	(2)
1. Trench excavation	62,000 c. y.	$2.24	$2.40
2. Excava. for structures	250 c. y.	2.00	3.00
3. Backfill	45,000 c. y.	.20	.34
4. Rock refill	100 ton	3.00	3.00
5. Conc. in structures	440 c. y.	27.00	26.00
6. Concrete in cradle	300 c. y.	7.00	7.50
7. Reinforcing steel, struct	44,000 lb.	.02	.03
8. Precast conc. pipe, dia. 41-in. std. lock joints	26,361 l. f.	4.11	4.15
9. As above, welded lock joints	4,034 l. f.	4.71	5.25
10. Steel cylinder rein., 14 ga	3,465 l. f.	3.44	2.70
11. Steel cylinder rein., 13 ga	1,803 l. f.	3.62	2.90
12. Steel cylinder rein., 12 ga	1,425 l. f.	3.80	3.10
13. Steel cylinder rein., 11 ga	767 l. f.	4.00	3.30
14. Steel cylinder rein., 10 ga	917 l. f.	4.16	3.45
15. Steel cylinder rein., 9 ga	971 l. f.	4.35	3.70
16. Steel cylinder rein., 8 ga	19,274 l. f.	4.54	3.90
17. Steel cylinder rein., ¼-in. thick	553 l. f.	5.73	6.30
18. Steel cylinder rein., ⅜-in. thick	115 l. f.	10.00	28.50
19. Steel cylinder rein., ⅜-in thick	10 l. f.	20.00	30.60
20. Rein. steel in precast conc. pipe	1,825,000 lb.	.042	.046
21. 42-in. spun mortar lined steel pipe, ½-in. thick	95 l. f.	20.00	15.50
22. Incasement under RR tracks	95 l. f.	40.00	22.50
23. Pipe coating, type B	1,500 s. f.	.20	.20
24. Steel manhole assemblies	14,000 lb.	.30	.25
25. Steel plate specials	20,000 lb.	.25	.25
26. Asbestoes cement pipe insulat. sections, 36-in. dia.	2 sect.	100.00	50.00
27. As above, 24-in. dia	1 sect.	75.00	40.00
28. Inst. misc. metalwork	66,000 lb.	.04	.04
29. Electrolysis test points, type 1	1 ea.	100.00	150.00
30. Electrolysis test points, type 2	1 ea.	100.00	150.00
31. Electrolysis test points, type 3	3 ea.	100.00	150.00
32. Cast iron pipe, sewer recon. 6-in	500 l. f.	2.00	2.50
33. Cast iron pipe, sewer recon. 8-in	50 l. f.	2.50	3.00
34. Cast iron pipe, sewer recon. 10-in.	50 l. f.	3.00	3.50
35. Cast iron pipe, sewer recon. 12-in	50 l. f.	4.50	4.00
36. Remodel house conn. sewers	100 l. f.	3.00	5.00

Schedule 33—Cast iron pipe with spun mortar lining
Sta. 4333 + 65 to 4620 + 53

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Trench excavation	36,000 c. y.	$0.30	$3.03	$2.90
2. Excava. for structures	240 c. y.	1.00	2.00	4.00
3. Backfill	30,000 c. y.	.10	.20	.40
4. Rock refill	100 ton	1.25	3.00	5.50
5. Conc. in structures	240 c. y	25.00	28.00	30.00
6. Concrete in cradle	1,200 c. y	5.00	7.00	7.00
7. Reinforcing steel, struct	27,000 lb.	.03	.02	.04
8. 29-in. spun mortar lined steel pipe ½-in. thick	54 l. f.	25.00	20.00	15.00
9. 28-in. c.i. pipe, .84-in. thick	3,275 l. f.	10.70	9.90	9.50
10. As above, .88-in. thick	20,578 l. f.	11.06	10.05	9.70
11. As above, .93-in. thick	4,403 l. f.	11.63	10.80	10.50
12. Incasement under RR tracks	54 l. f.	30.00	40.00	13.00
13. Pipe coating, type A	100 s. f.	.25	.30	.50
14. Pipe coating, type B	500 s. f.	.25	.30	.25
15. Steel plate specials	4,000 lb.	.20	.35	.30
16. Special iron castings	140,000 lb.	.13	.15	.17
17. Misc. metalwork, install	46,000 lb.	.05	.04	.10
18. 6-in. c.i. pipe, sewer reconstr	500 l. f.	1.50	2.00	3.00
19. 8-in. c.i. pipe, sewer reconstr	180 l. f.	2.00	2.50	3.50
20. 10-in. c.i. pipe, sewer reconstr	50 l. f.	3.00	3.00	4.00
21. 12-in. c.i. pipe, sewer reconstr	50 l. f.	3.50	4.50	5.00
22. Remodel house conn. sewers	100 l. f.	2.00	3.00	3.50

INTERCEPTOR SEWER INDIANA

OWNER: Board of Public Works, City of Indianapolis, Ind.: L. Brandt, chairman; M. G. Johnson, city engineer.

PROJECT: Construction of White River interceptor sewer, 2,756-ft. long, Washington Ave. to West New York St., Indianapolis, Ind. Reinforced concrete pipe 54 and 72-in. diameter, and 12-in. vitrified clay and 48-in. corrugated metal pipe included in work, as well as house and sanitary sewer connections.

CONDITIONS: All materials to be furnished by contractor. No definite time set for completion as construction is contingent upon finishing of other flood protection work. Highway transportation facilities available. Wage rates are: skilled labor, 75c. per hr.; semi-skilled, 60c.; and common labor, 50c. per hour.

BIDS: Three bids were opened August 7, 1940, ranging from contract low of $39,978 to $44,098.

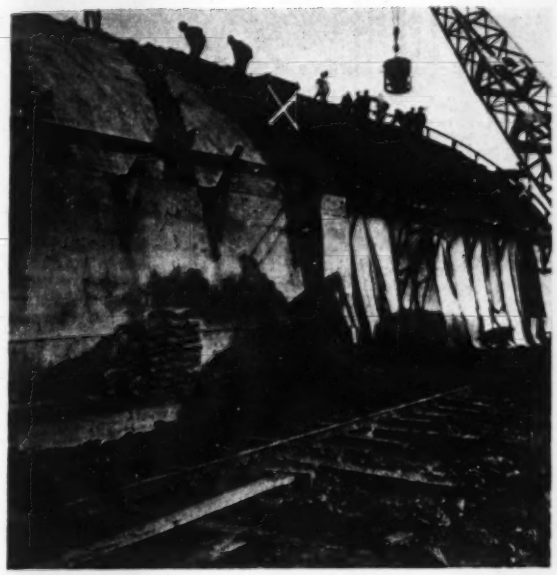
LIST OF BIDDERS:

1. Columbia Constr. Co., Indianapolis, Ind. (contract) $39,978
2. Sheehan Constr. Co., Indianapolis, Ind. 43,672
3. D. W. Johnson, Inc., Indianapolis, Ind. 44,098

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excavation	5,070 c. y.	$0.85	$0.80	$0.75
2. 54-in. rein. conc. sewer (cradle)	1,092 l. f.	13.00	12.65	15.00
3. 54-in. rein. conc. sewer	798 l. f.	10.00	10.35	10.50
4. 72-in. rein. conc. sewer	350 l. f.	17.00	15.55	18.35
5. 48-in. corr. metal pipe	94 l. f.	10.00	17.65	11.25
6. 12-in. vitr. clay pipe sewer	422 l. f.	1.00	1.20	1.00
7. 12-in. by 6-in. vit. clay wyes	10 ea.	4.00	4.80	3.00
8. 6-in. house connections	430 l. f.	1.00	.95	1.15
9. Sanitary sewer connections	120 l. f.	3.00	2.30	3.00
10. Std. concrete manholes	9 ea.	100.00	115.00	100.00
11. Rein. conc. conversion manhole	1 ea.	850.00	747.50	1,150.00
12. Headwall outfall structure	1 ea.	1,000.00	920.00	800.00
13. Seal and fill abandoned 72-in. sewer	L.S.	2,000.00	3,500.00	3,500.00
14. Miscellaneous items, not listed	L.S.	600.00	3,000.00	400.00

CONSTRUCTION PREPAREDNESS

NAVY'S SHIP-MODEL TESTING BASIN READY SIX MONTHS AHEAD OF SCHEDULE



15,000 BARRELS of 'Incor' 24-Hour Cement, used in concrete roof of U. S. Navy Ship-Model Testing Basin, Carderock, Md., aided in completion six months ahead of contract date. About 60,000 bbl. of Lone Star Cement were also used.

. . . TYPICAL OF TIME-SAVING ON BUILDINGS, BRIDGES, HIGHWAYS—THROUGH GOOD JOB PLANNING AND USE OF 'INCOR' 24-HOUR CEMENT

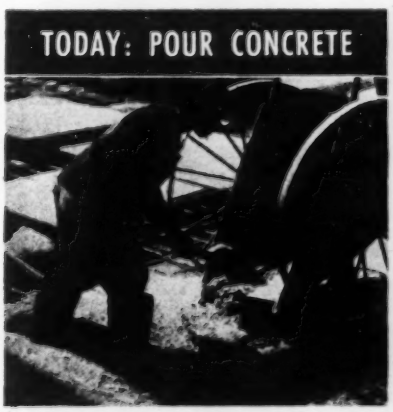
VITAL months saved . . . new plants in production weeks sooner . . . through good job planning and the use of 'Incor' 24-Hour Cement. Forms are filled with 'Incor' concrete one day, stripped the next, saving four to five days on each pour. Immediate form re-use cuts costs—fewer form-sets needed. And earlier completion reduces overhead expense.

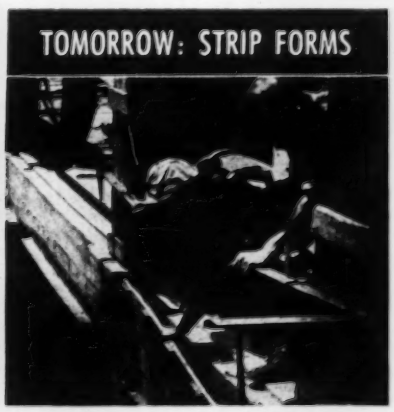
Navy Engineers, recognizing these economies, specified high early strength cement for the roof of the new Ship-Model Testing Basin (left). 'Incor' strengths exceeded form-removal specifications—helped Turner Construction Co., New York, general contractor, complete the structure six months ahead of contract date.

'Incor's dependable 24-hour service strength saves time, cuts costs . . . and 'Incor' quality assures long-time durability. An 'Incor'* engineer will be glad to confer with you on concrete problems. Lone Star Cement Corporation, 342 Madison Avenue, New York. *Reg. U. S. Pat. Off.

USE 'INCOR', FOR MAXIMUM SPEED AT MINIMUM COST

13 YEARS' performance: Over 10-million barrels of 'Incor' have been used. That means service and performance . . . based on the quality and uniformity of this *first* high early strength Portland cement.





LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT . . . 'INCOR' 24-HOUR CEMENT

One of the two model 10125 AMERICAN REVOLVERS owned by Griffith Company and Bent Company and used to place all materials in the Friant Dam now under construction. Both machines have 125 foot booms and are mounted on 54 foot traveling gantries with 22 foot portal clearance. Travel speed 125 FPM.

TWO MODEL 10125

AMERICAN REVOLVERS

DO THE HEAVY WORK ON THE FRIANT DAM

Placing forms, reinforcing steel and concrete the two AMERICAN REVOLVERS owned by Griffith Company and Bent Company have made a flying start on the 1,900,000 cubic yards of concrete that will be poured in the Dam.

Ask us for the figures proving the low first cost, low operating expense and high efficiency of

AMERICAN REVOLVERS . . .

Get the story anyhow; it will not cost you a penny and it may make the difference between a profit and a deficit on your contract.

AMERICAN HOIST & DERRICK CO.

NEW YORK SAINT PAUL, MINNESOTA CHICAGO

AMERICAN TERRY DERRICK CO.

SOUTH KEARNY, N. J.

Write for a copy of "WITH AN EYE TO SAFETY"

FOR SAFE WIRE ROPE FASTENING

STANDARDIZE *on the Genuine* CROSBY CLIP

PERFECT GRIP • DROP FORGED STEEL • HOT DIP GALVANIZED

DEALERS WITH STOCK IN ALL PRINCIPAL CITIES

ABSTRACTS AND NOTES

Ohio Health Department Reports Last Year's Work Reaches Peak

A new peak in volume and valuation was reached in 1939 for municipal sanitary improvements in Ohio. According to the annual report of F. H. Waring, chief engineer, important waterworks improvements were undertaken in 24 different cities and 44 villages. Likewise major sewerage improvements were carried out in 25 cities and 45 villages. Valuations were $9,304,900 for water projects and $9,136,575 for sewerage. With $117,700 for combined plants in school projects the total is 24 per cent greater than 1938 and 58 per cent greater than the average for the last eleven years. It is the greatest effort in construction of sanitary improvements in the history of the department.

Certification after examination of operating personnel of water and sewage treatment plants was extended to 136 water operators and 136 sewage plant operators. Outstanding now are certificates to 486 water operators and 320 sewage treatment operators. Each class has four grades. All certificates heretofore have been issued under a "Grandfather's Clause," 1939 being the first to require examinations.

Court Reduces Assessed Value Of Contractor's Equipment

The court found in favor of the contractor in a suit recently brought by the Guy F. Atkinson Co. against the county of Los Angeles, contesting the value which a deputy county assessor had placed on certain construction equipment. The assessor arrived at his appraisal, it was said, by taking the cost assigned by the taxpayer on his books to the property and depreciating it. The contractor appealed to the Board of Equalization which upheld the assessment and the court proceedings followed.

The court held that the depreciated book value method of determining the assessment was not proper, but that it should be arrived at by taking 50 per cent of the "true cash value" of the equipment, pursuant to

(Continued on p. 116)

A section of the Leschen Laboratory where wire is being tested to determine its fitness. In this department are many other instruments, among which is an 800,000 pound capacity machine for determining the actual breaking strength of completed wire ropes.

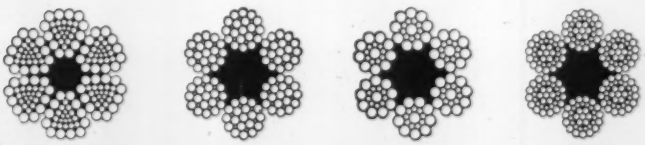
Rigid tests leave nothing to chance

The illustrations at the right show a few of the many constructions in which "HERCULES" is available. All can be furnished either Standard or Preformed. We would welcome the opportunity to recommend the construction and type we consider most suitable for your conditions.

"HERCULES" (Red-Strand) Wire Rope owes much of its outstanding performance record to the many rigid tests that must be undergone and survived, even before its actual manufacture begins.

In reality our entire plant is a proving ground from receiving door to shipping platform. Following the thorough testing of all materials, exacting inspections are made by experienced workmen during each step in the process of manufacture.

Your proving ground for wire rope is where you use it. Because of our accurate control of quality during manufacture, you can depend on "HERCULES" (Red-Strand) Wire Rope for maximum operating economy. And it is on the job . . . *your* proving ground . . . where "HERCULES" has won and where it continues to maintain its enviable reputation.



Style G Flattened Strand | 6x19 Filler Wire | 6x19 Seale | 6x37 Type

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

NEW YORK . . . 90 West Street
CHICAGO . . 810 W. Washington Blvd.
DENVER . . . 1554 Wazee Street

HERCULES (RED-STRAND) WIRE ROPE

SAN FRANCISCO . . 520 Fourth Street
PORTLAND . . 914 N. W. 14th Avenue
SEATTLE . . 3410 First Avenue South

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

INCREASES in lumber prices in twelve of the twenty cities reported by *ENR* are the most important price changes for September. Short Leaf Yellow Pine is up 50c. per M ft. in Atlanta; up $2.00 in Baltimore, Chicago and New York; $3.50 to $5.50 higher in Birmingham; $3.00 to $4.00 in Cleveland; up $1.50 to $3.00 in Detroit; up $1.00 on 1-in. sizes in Kansas City; and $3.00 higher in St. Louis. Long Leaf Yellow Pine is $4.50 to $12.00 higher in Birmingham. Native pine is mixed in Denver, off $1.00 on 1-in. sizes, but up $3.50 on 2x4-in. and $4.50 on 2x6-in. sizes. Douglas Fir increased $1.00 to $2.00 in Chicago and Minneapolis, $2.00 to $3.00 in Kansas City and Montreal, and $1.00 in New York.

Portland cement prices are 2c. per bbl. higher in Denver, the only change in the 20 cities. Ready-mixed concrete is 25c. per cu. yd. lower in Kansas City. Paving asphalt is 81c. per ton lower in Cincinnati, but is up $1.00 in Cleveland. Granite blocks are up $10.00 per M in Baltimore.

Structural steel shape and reinforcing bar prices have been reaffirmed for the fourth quarter, but minor increases are reported in the latter in Baltimore, Cincinnati, St. Louis, San Francisco and Seattle.

Structural ironworkers rate in Birmingham increases 12½c. per hour to $1.37½ for the only change in the skilled labor wages. The common labor rate is 6c. per hour higher in Baltimore, but is off 5c. per hour in New Orleans.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL			CRUSHED STONE		CRUSHED SLAG		CONCRETE
	Per bbl., carload lots, including 40c per bbl. for bags, cash discount not deducted			Per ton, carload lots			Per ton, carload lots		Per ton, carload lots, f.o.b. plant		Ready Mixed 1:2:4, 50 c.y. or more delivered
	Cloth Bags *a*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.66	$2.61	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.90
Baltimore	2.31	2.06	1.86	1.70‡	1.70‡	1.20‡	1.75‡	1.75‡	1.75‡	1.75‡	6.50
Birmingham	2.50	2.25	2.05	1.75	1.75	1.50	1.00	1.00	.90	1.15	5.80
Boston	2.75*b*	2.50*b*	2.30	1.20‡	1.20‡	.90‡	1.20‡	1.20‡	....	....	6.75*m*
Chicago	2.60	2.35	2.20	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	1.25‡	1.25‡	....
Cincinnati	2.58	2.33	2.08	1.20	1.20	1.10	1.80	1.80	....	....	6.60
Cleveland	2.00	1.75	....	1.45*i*	1.45*i*	1.30*i*	1.70*i*	1.70*i*	1.70*i*	1.70*i*	6.55*i*
Dallas	2.30	2.05	1.85	2.00*p*	2.00*p*	1.50*p*	1.69*p*	1.84*p*	....	....	6.20
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.23	1.98	1.78	1.30	1.40	.80	1.30	1.45	1.02‡	1.14‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.25*o*
Los Angeles	2.25*b*	2.05*b*	....	1.00	1.00	1.00	1.00*f*	1.00*f*	....	....	5.85
Minneapolis	2.90	2.65	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.35*j*
Montreal	....	1.82*r*	1.67*r*	....	....	1.25‡	.85‡*c*	1.00‡*c*	....	....	6.45*l*
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.60‡	2.35‡	....	1.25*de*	1.25*de*	.75*de*	1.65*de*	1.75*de*	....	....	6.75
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.40‡	1.40‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.50
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	.85*h*	.85*h*	.75*g*	.75*g*	7.50
San Francisco	2.16	1.96	1.66	1.36	1.36	1.36	1.46	1.46	....	....	6.95
Seattle	2.95*o*	2.70*o*	....	1.00*o*	1.00*o*	1.00*o*	2.00*o*	2.00*o*	....	....	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. for cash. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *r* 10c. per bbl. off, cash 20 days.

CASH DISCOUNTS CEMENT to Contractors: truck delivery. 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

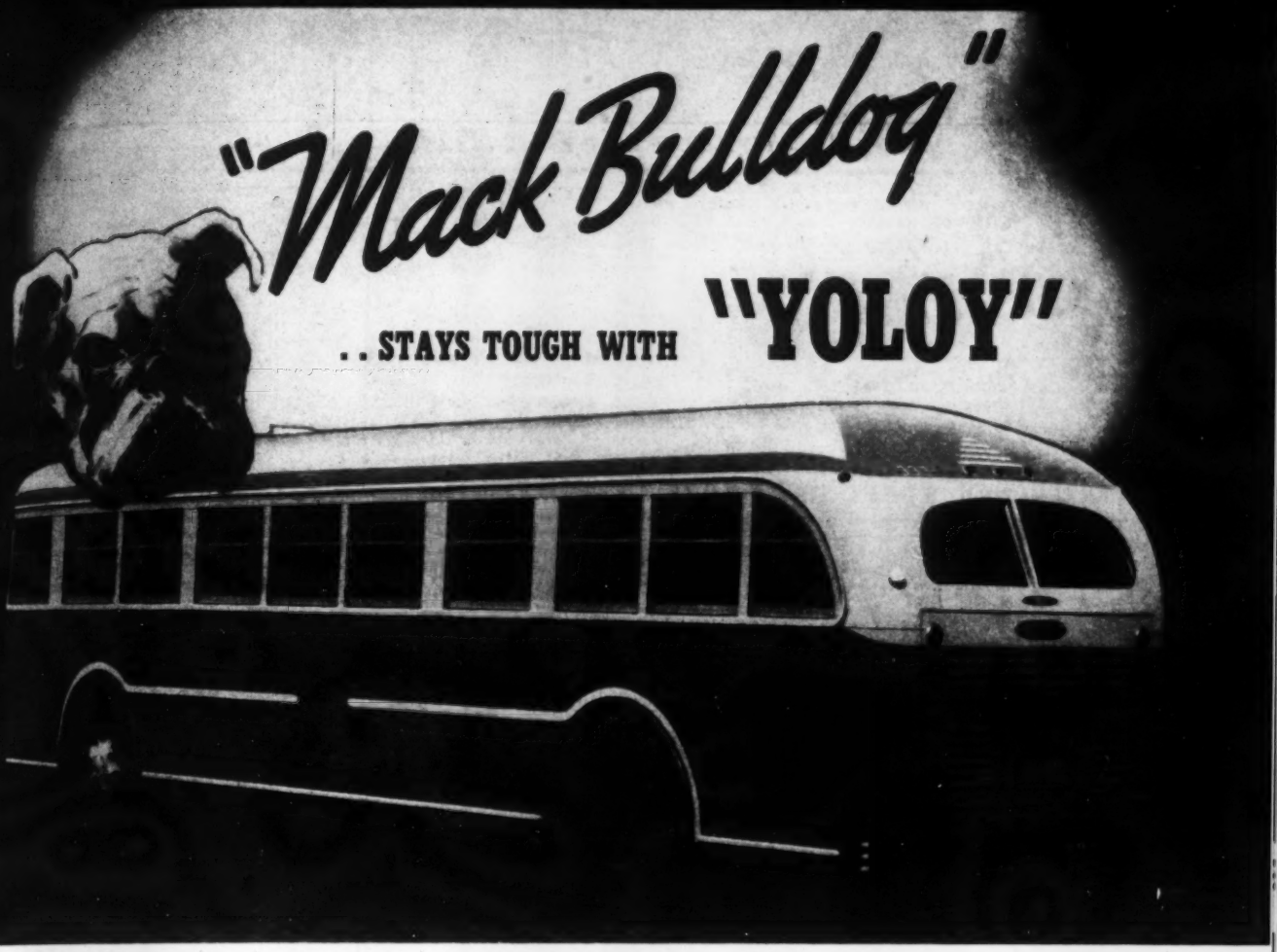
Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	$1.80	$1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo.	1.70	1.65	Norfolk, Va.	1.65	1.60	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex (5c. tax in Tex.)	1.75	1.70
Independence, Kans.	1.70	1.65	Norin Birmingham, Ala.	1.70	1.65	Montreal	1.55	1.55

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION (Quick-breaking)
	Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3½x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Per ton, less than 80 penetration		Per gal., 80 300 penetration		Per ton		Per gal.	Per gal.
				Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$39.35	$2.25	$17.30*e*	$23.83*e*	$0.0695*e*	$0.1018*e*	$0.0734*he*	$0.1257*h*	$0.0634*e*	$0.0734	$0.1257
Baltimore	150.00‡	45.00‡	2.75	14.00	20.00	.06	.09	.065*h*	.115*h*	.....	.....	.....
Birmingham	.....	27.50*f*‡	....	18.20	23.20	.0747	.1047	.0834*h*	.1484*h*	.....	.....	.....
Boston	90.00	47.50	3.25	14.00	20.00	.06	.09	.065*h*	.115*h*	.....	.09‡	.12‡
Chicago	140.00	50.00	1.80*d*	14.50	18.50	13.00*g*	17.00*g*	.06*h*	.095*h*	.04	.09	.125
Cincinnati	112.00	37.50	....	13.50	17.50	.10	.....	16.80	.....	.0525	.....	.075
Cleveland	110.00	37.50	2.80	15.50	20.50	.065	.075	.075*h*	.085*h*	.0375	.08	.09
Dallas	.....	30.00	....	13.25	20.30	.06	.103	15.00	24.80	.055	.05/.07	.07/.09
Denver	.....	27.50	....	....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	....	13.15*f*	18.45*f*	.061	.0984	13.15	17.20	.0475	.061	.0923
Kansas City	.....	40.00	....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	....	6.50*b*	15.00	6.50*bg*	15.00*bg*	5.50*b*	.....	.0192	.0525	.1125
Minneapolis	.....	.....	1.90*d*	19.20	24.20	.10	.12	19.30	28.30	.056	.....	.....
Montreal	75.00	.....	3.62	14.60	21.25	.105	.137	.101*h*	.121*h*	.07	.135	.185
New Orleans	.....	.....	....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	.....	.078	.....
New York	.....	.....	2.75	15.00	21.00	.06	.09	.065*h*	.115*h*	.....	.07	.11
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06*h*	.09*h*	.05	.06	.09
Pittsburgh	135.00	38.75	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	....	14.00	19.00	14.00*g*	19.00*g*	.06*h*	.095*h*	.04	.09	.125
San Francisco	.....	70.00	....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0525	.1125
Seattle	.....	60.00*c*	....	14.70	24.10	.....	24.10*g*	9.50/10.50	23.00/24.00	7.75*g*	.0575*i*	.1308*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3x3½x8½ in.



THE Bulldog trademark of the International Motor Truck Company has long stood as a symbol of the staunch stamina of their widely-known line of Mack Trucks and Buses. Yoloy makes an important contribution to the toughness and durability of Mack construction and has been used for body framing and chassis on jobs such as this United Traction Company bus for the City of Albany.

Yoloy is a high tensile, low alloy steel developed by Youngstown. Compared to regular materials Yoloy will reduce weight 25% to 40% for equal strength, has a corrosion resistance 4 to 6 times greater. In addition Yoloy has excellent welding properties, forms well, yet has a high impact resistance.

Investigate Yoloy for your products now. Yoloy will cut down dead weight, increase payloads and insure better profits for transportation vehicles.

YOLOY TRADE MARK YOUNGSTOWN STEEL

High Tensile Steel Yoloy is available in sheets, strips, plates, bars, shapes, manufacturer's wire, welding wire, seamless pipe, and electric weld pipe.

3-10-C

YOUNGSTOWN
SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - YOUNGSTOWN, OHIO

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¾-in. billet *b*	RIVETS ¾-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES: Angle Bars	Std. Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.15	$3.40	$2.55	.....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.15	3.40	2.55	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.15	3.40	2.55	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.15	.....	.....	2.40	.....	.....	.....	.....	.....	2.15	.....
Cleveland	2.10	2.15	3.40	2.55	.....	.....	.....	.....	.....	.....	.....	.....
Youngstown	.....	2.15	.....	.....	.....	.....	.....	.....	.....	3.00	.....	.....
Detroit	.....	2.25‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gulf ports	2.45*a*	2.50*a*	.....	.....	2.85*a*	.....	.....	.....	.....	.....	.....	.....
Pacific ports	2.75*a*	2.55*a*	.....	.....	2.95*a*	.....	.....	.....	.....	3.00	2.30	.....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates, alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

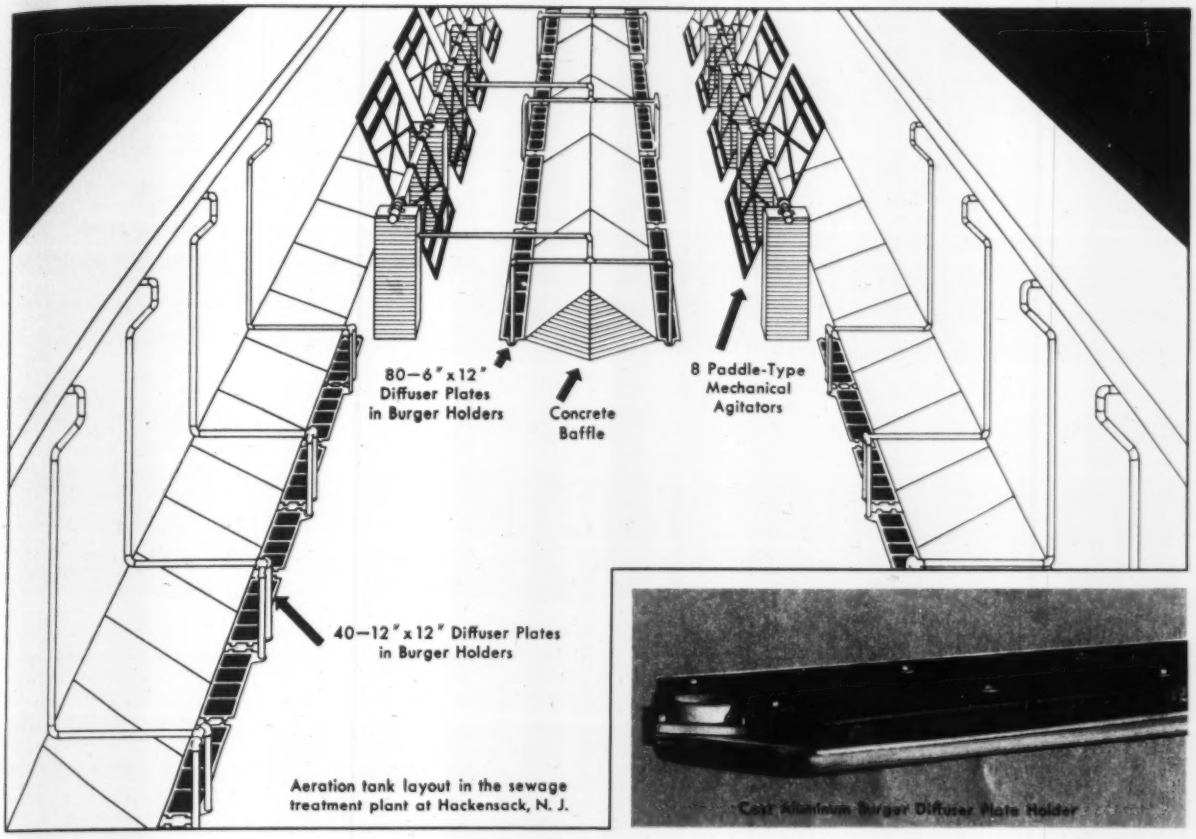
	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS* Per 100 lb., ¾ in., base price: 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH—Per 100 sq.yd.. carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING—Per 100 s.f.. carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET-PILING Per 100 lb. base price
Atlanta	$2.34	$2.39	$2.14	.02½	.10	$21.00	$23.00	$1.82	*1.35	$0.1719	$3.04
Baltimore	3.70	2.90	2.75	.....	.10	24.00	26.00	1.70	1.27	.1611	2.90
Birmingham	2.10*a*	2.15	2.15	.02½	.10	20.50	22.50	1.80	1.34	.1701	....
Boston	3.85	2.61	2.46	$20 C.L.	.10	21.50	23.50	1.76	1.31	.1656	3.14
Chicago	2.10*a*	2.15	2.05	.03	.05	19.50	21.50	1.67	1.25	.1575	2.40
Cincinnati	3.68	2.46*c*	2.36*c*	.....	.05	20.50	22.50	1.66	1.25	.1566	....
Cleveland	3.58*g*	2.15	2.05	.02½	.10	22.50	23.50	1.66	1.25	.1566	....
Dallas	4.75	3.25	3.25	.....	.....	25.00	27.00	1.93	1.42	.1827	....
Denver	4.35	3.95	3.80	.....	.....	23.5*c*	25.50	1.97	1.45	.1863	....
Detroit	3.60‡	2.35	2.20	.....	.10	22.50	24.50	1.68	1.26	.1584	2.66
Kansas City	4.00	2.51*c*	2.36*c*	.0	.05	18.50	21.50	1.78	1.33	.1683	2.86
Los Angeles	3.65*f*	2.10	2.10	.02½	.05	23.00	27.50	1.93	1.42	.1827	3.65
Minneapolis	3.80‡	2.48*c*	2.33*c*	.0	.10	19.50/20.50	21.50/22.50	1.80	1.34	.1701	2.73*d*
Montreal	.....	.....	2.60	.....	....	26.50	29.00	2.99	2.08	.319	....
New Orleans	4.40	2.52	2.52	.05	.10	21.50	23.50	1.82	1.35	.1719	2.87*5*
New York	3.75	2.39	2.29	.....	.10	14.50	16.50	1.76	1.32	.1665	2.74
Philadelphia	3.55	2.66	2.56	.....	.....	19.50	21.50	1.71	1.28	.1611	2.72
Pittsburgh	2.10*a*	2.15	2.05	.02½	.10	21.50	24.50	1.59	1.20	.1503	2.40
St. Louis	3.47	2.39	2.29	.0	.05	24.00	28.00	1.69	1.27	.1602	2.70
San Francisco	3.35	2.325	2.475	.02½	.10	19.00	25.50	1.93	1.42	.1827	3.25
Seattle	2.75*e*	2.50*e*	.....	.....	.....	25.50	27.50	1.93	1.42	.1827	2.95*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c.; 1 to 5 tons, add 10c. High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE: Per foot, std. 8 in., s.s.	delivered std. 12 in., s.s.	ASTM C13-35 24 in.,	36 in.,	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14-35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h*: 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in.; Lap Weld Black %	Galv. %
Atlanta	$49 40	$0.26*b*	$0.468*bc*	$1.8525	$4.68*c*	$85.00	$128.00	$0.45	$1.642	62.2	54.2	59.7	51.2
Baltimore	52.80	.30	.55	2.30	6.80	110.00	150.00	.50	1.75	65.5	57.5	63.00	54.5
Birmingham	45.00	.26	.468	1.7875	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	55.00	.231	.4455	1.89	5.2275	180.00‡	280.00‡	.50	2.30	64.1	56.1	61.6	53.1
Chicago	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	52.70	.245	.4995	1.9335	5.6375	105.00	170.00	.60	1.70	65.9	57.9	63.4	54.9
Cleveland	54.24	.196	.378	1.485	4.51	69.00	108.00	.35	1.50	67.8	59.8	65.3	56.8
Dallas	58.20	.28	.504	2.016	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	60.60	.24†	.52†	2.16†	.....	130.00	240.00	....	....	58.4	50.4	55.7	47.2
Detroit	54.24	.245	.4725	1.935	4.408	66.45	105.00	.33	1.50	66.3	58.3	63.8	55.3
Kansas City	55.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	59.6	51.6	57.0	48.6
Minneapolis	57.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.55	.90	3.68	5.95*e*	135.00‡	260.00‡	.48	1.92	.....	.....	.....	.....
New Orleans	51.38	.26	.48	1.69	.....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	52.20	.32	.63	2.52	6.45	.....	.....	.50	1.20	64.9	56.8	62.4	53.9
Philadelphia	50.90	.....	.....	.....	.....	.....	.....	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85*g*	2.00*g*	68.5*i*	60.5*i*	66.0*i*	57.5*i*
St. Louis	52.48	.24	.432	1.728	3.96	85.00	170.00	.70*j*	1.60*k*	65.1	57.1	62.0	53.5
San Francisco	55.00	.3275*d*	.5895*d*	2.358	5.895	107.25	178.75	.54	2.50	.....	.....	.....	.....
Seattle	55.35	.35	.63	2.52	6.30	72.00	175.00	.45*f*	1.40*f*	.....	.....	.....	.....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N.J. (base) $49.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8½c.; ½ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld—1 in. and 1¼ in. black 34, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld—2½ in. to 3½ in. black 31½, galv. 17½ in.; 4½ in. to 8 in. black, 32½ galv. 20. *j* Reinforced; spec. C 76-37. *k* Reinforced; spec. C 75-37.



Aeration tank layout in the sewage treatment plant at Hackensack, N. J.

Cast Aluminum Burger Diffuser Plate Holder

These aeration tanks are planned for flexible operation

This interesting installation of air diffusers and mechanical agitators is in service at the Hackensack, New Jersey, sewage treatment plant. Employment of these two mediums in different combinations, to suit variable operating conditions, makes the system extremely flexible.

A row of wide diffuser plates is placed along the side of each aeration tank, for the first third of its length. Then, an A-shaped concrete baffle divides the tank down the middle, and two rows of narrower diffuser plates flank this baffle. The action of these plates is supplemented by large paddle wheels.

Cast Aluminum holders of the Burger design simplify installation and maintenance of diffuser plates. Holders carrying five plates each are handled as units, their light weight making the job go faster and easier. Plates are removed without danger of breakage, simply by loosening several bolts; they are made air- and water-tight by durable rubber gaskets. These holders are nonrusting.

ALUMINUM COMPANY OF AMERICA, 2108 Gulf Building, Pittsburgh, Pennsylvania.

LUMBER, TIMBER, PLYWOOD — PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)									LONG LEAF Y. P.		PLY
	All Fir planks No. 2 common: Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									Merchantable grade up to 20 ft.		Rail freig (See note fo
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 R2S	6x12 R2S	12x12 R2S	2x12 R2S	12x12 R2S	¾"
Atlanta	**$20.50**	**$20.50**	**$20.00**	**$19.50**	**$19.50**	**$22.00**	**$27.00**	.....	.....	$37.50	$50.50	$17.75
Baltimore	**33.00**	**34.50**	**34.00**	**35.00**	**35.00**	**36.00**	**48.00**	.....	.....	70.00	72.00	17.35*g*
	35.00	*35.00*	*37.00*	*36.00*	*36.00*	*35.00*	*48.00*	*$48.00*	*$48.00*	.....	.....	.....
Birmingham	**25.50**	**26.00**	**25.00**	**25.00**	**25.50**	**28.00**	**42.00**	**59.00**	**59.00**	.....	.....	16.25
[1]	30.00	31.00	30.00	29.00	31.00	40.00	60.00	.....	.....	62.00	65.00	.....
Boston	31.00[2]	31.00[2]	34.00[2]	34.00	55.00[2]	63.00[2]	80.00[2]	.....	.....	80.00	80.00	17.35*g*
	30.00	*30.00*	*34.00*	*34.00*	*40.00*	*40.00*	*48.00*	*48.00*	*48.00*	.....	.....	.....
Chicago	**33.00**	**34.00**	**32.00**	**32.00**	**32.00**	**34.50**	**50.00**	.....	.....	80.00	90.00	13.80
	37.00	*39.00*	*38.00*	*39.00*	*39.00*	*40.00*	*43.00*	*42.00*	*42.00*	.....	.....	.....
Cincinnati	**31.50**	**33.00**	**30.50**	**31.00**	**32.00**	**35.00**	**44.50**	.....	.....	53.00	56.00	16.25
	.....	.....	.....	.....	.....	.....	*46.00*	*46.00*	*46.00*	.....	.....	.....
Cleveland	**35.00**	**36.00**	**36.00**	**34.00**	**32.00**	**38.50**	**45.00**	45.00	45.00	80.00	80.00	16.70
Dallas *e*	**28.50**	**32.50**	**31.50**	**29.00**	**30.50**	**32.50**	**52.50**	**52.50**	**52.50**	63.50	71.00	13.90
Denver ‡	44.00[4]	43.00[4]	46.50[4]	45.50[4]	41.00[4]	46.00[4]	48.00[4]	60.00[4]	71.50[4]	.....	.....	9.90
Detroit	**38.00**	**38.00**	**38.00**	**38.00**	**40.00**	**43.50**	**48.00**	.....	.....	44.50	59.00	16.25
	.....	.....	.....	.....	.....	*48.00*	*49.00*	*56.00*	*56.00*	.....	.....	.....
Kansas City	**30.00**	**30.50**	**29.00**	**28.00**	**28.50**	**30.00**	**35.00**	.....	.....	55.00	60.00	12.25
	31.50	*32.00*	*32.50*	*30.50*	*31.00*	*32.50*	*35.00*	*39.00*	*39.00*	.....	.....	.....
Los Angeles *a*	*36.00*	*35.00*	*36.00*	*33.00*	*33.00*	*33.00*	*38.00*	*46.00*	*39.00*	.....	.....	9.35*gh*
Minneapolis ‡*b*	36.00[6]	36.00[6]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05
‡	*38.50*	*39.50*	*37.00*	*35.50*	*35.50*	*37.50*	*43.00*	*52.00*	*52.00*	.....	.....	.....
Montreal [7]	*35.00*	*36.50*	*33.00*	*35.00*	*36.50*	42.50	45.00	.....	.....	155.00	165.00	.....
	55.00	*57.00*	*55.00*	*59.00*	*60.00*	*60.75*	*54.00*	*54.00*	*54.00*	.....	.....	.....
New Orleans	**24.00**	**25.00**	**25.00**	**24.00**	**24.00**	**25.00**	**46.00**	.....	.....	62.00	69.00	13.90
	29.00	*29.00*	*32.00*	*33.00*	*35.00*	*34.00*	*36.00*	.....	.....	.....	.....	.....
New York ‡	**40.00**	**41.00**	**39.00**	**40.00**	**40.00**	**41.00**	**44.00**	.....	.....	82.50*f*	85.00*f*	17.35*g*
‡	.....	.....	*46.00*	*46.00*	*46.00*	*46.00*	*46.00*	*51.00*	*51.00*	.....	.....	.....
Philadelphia	**24.00**	**24.50**	**25.50**	**25.50**	**27.50**	**27.50**	**29.00**	.....	.....	50.00	57.50	17.35*g*
	35.00	*36.50*	*39.00*	*38.25*	*29.00*	*39.00*	*44.00*	*32.00*	*32.00*	.....	.....	.....
Pittsburgh	**38.10**	**39.90**	**47.05**	**42.00**	**45.65**	**46.90**	**59.70**	.....	.....	.....	.....	17.00
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....
St. Louis ‡*c*	**35.00**	**36.00**	**34.00**	**33.00**	**34.00**	**35.00**	**48.00**	*52.00*	*52.00*	73.00	72.00	13.90
San Francisco *d*	*22.50*	*23.00*	*23.00*	*22.50*	*22.00*	*22.00*	*23.50*	*23.50*	*23.50*	.....	.....	7.30*gj*
Seattle	*21.00*	*21.00*	*21.00*	*21.00*	*21.00*	*21.00*	*26.00*	*26.00*	*26.00*	.....	.....	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off. *f* Up to 18 ft.

NOTE: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface Seattle base price on ⅜", $77.00; on ¾", $84.80; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
	A quality	B quality		
Atlanta	75%	75%	$0.15	
Baltimore	83%	82%	.15	
Birmingham	75%	75%	.105	
Boston	82%	82%	.15	
Chicago	79%	79%	.15	
Cincinnati	77%	77%	.15	
Cleveland	79-10-10%	79-10-10%	.205	
Dallas	78%	78%	.165	
Denver	76-10%	76-10%	.15*e*	
Detroit	79-10%	79-10%	.15	
Kansas City	77-10%	77-10%	.165	
Los Angeles	86%*d*	88%*d*	.1575	
Minneapolis	76%	76%	.155	
Montreal	60-5%*ab*	.....	.17†	
New Orleans	70%	75%	.16	
New York	81%	82%	.22*f*	
Philadelphia	82-10%*d*	83-10%*d*	.15	
Pittsburgh	79%	79%	.1425	
St. Louis	79-10%	79-10%	.155	
San Francisco	78%*d*	83%*d*	.155	
Seattle	85%*d*	88%*d*	.1575	

Price of 60% Ammonia Gelatin is $0.015 per lb. higher than 40%

a Disc. from list Sept. 1939. *b* Also less 6% tax exemption. *d* Discount from jobbers' list Sept. 15, 1928.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla	$0.105	$0.14	$0.16
W. of Miss. to Rocky Mtn. States, and Fla	.11 -.12	.135 -.15	.155 -.17
Rocky Mtn. States	.11 -.1325	.13 -.145**	.15 -.165**
Pacific N. W. States	.1075-.115	.1375-.15	.1575-.17
Pacific S. W. States	.1050-.1175	.135 -.1475	.155 -.1625

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES — F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Barge	Leaf Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.225	.24
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.23	.255
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.24	.265
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.28	.275
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.40	.415
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie for carload lots:

		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.20	....	$1.65	....
	Pine	1.50	$2.25*a*	2.25	$3.20*a*
New York	S. L. Sap Pine	1.10/1.20	1.85	1.50	2.35
	Mixed Oak	1.45	1.95	1.90	2.45
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	1.12	....	1.50	....
	Red Oak	1.12	1.60*a*	1.50	2.05*a*
	Sap Pine or Cypress	1.02	....	1.40	....
San Francisco	Douglas Fir	.90*bef*	....	....	1.95*bef*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6" x 8" x 8'6". *e* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00-2.85
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	20.50-35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb	4.45

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED Per M. lots of 2,000 pieces or over.			STRUCTURAL CLAY TILE—LOAD BEARING—SCORED Per M. lots of 2,000 pieces or over.			BRICK Per M. in quantity.		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton. Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized or lump
Atlanta	$90.00	$100.00	$185.00	$220.00	$230.00	$240.00	$12.50	$16.00	$26.50	$17.00	$17.00
Baltimore	75.00	80.00	150.00	180.00	225.00	280.00	14.00*k*	17.00*k*	18.50	14.50	2.50*m*
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	13.50	16.50	17.11	11.64	1.56*o*
Boston	95.05*a*	101.40*a*	190.05*a*	215.35	279.20*a*	319.10*a*	17.00*i*	20.00*i*	21.00	14.00	18.00*l*
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.00	12.00	16.40	14.40	12.20
Cincinnati	61.40	65.30*c*	121.90	141.50	187.30	215.20	16.00	16.00	15.90	13.00	.....
Cleveland	56.50	60.00	112.50	135.00	182.50	209.00	16.00	16.00	15.00*j*	12.00*j*	2.75*jm*
Dallas	62.50	67.00	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	.95*n*
Denver	84.80	95.40	152.70	178.20	212.00	227.90	13.50	17.00	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*c*	15.70	17.00	13.50	11.75	12.75
Kansas City	64.50	66.50	86.00*c*	125.50	159.75	186.25	14.25	24.00	19.10	12.80	10.70
Los Angeles	73.50*tr*	89.50*tr*	128.00*ctr*	210.00*tr*	368.00*tr*	460.00*tr*	13.50	15.00	16.50	.....	17.50
Minneapolis	71.45	76.20	143.95	171.45	173.80	242.10	13.10	15.10*g*	21.00	16.00	19.00
Montreal	72.20*a*	77.50*a*	142.50*a*	76.00*at*	165.80*a*	248.70	20.75	28.00	23.50	17.00	12.00
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00*c*	193.30*h*	238.80*h*	295.60*h*	13.00	.....	19.00	14.00	17.00
Philadelphia	80.50	85.90	161.10	193.30	238.80	295.60	15.50*i*	18.00*i*	15.50*l*	9.55*q*	12.05*l*
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.90	15.40	2.55*m*
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*lm*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*s*	20.00*s*	20.00*s*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6x12x12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c. per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 25-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

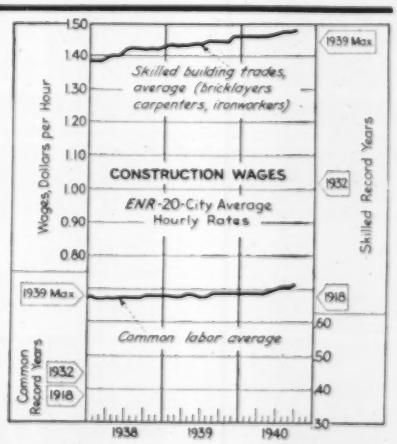
	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl. per ton
Atlanta	$8.50	$13.125	$1.30	$2.25	$1.20	$1.90	$1.61	$1.61	$0.27	$29.00
Baltimore	8.25	12.75	1.75	2.50	2.00	2.25	2.85	2.85	.50	27.50
Birmingham	8.50	13.125	2.35	2.75	1.85	1.98	1.57	1.57	.32	27.00
Boston	8.25	12.75	1.80‡	2.40‡	1.75‡	1.75‡	1.85*h*‡	1.85*h*‡	.50‡	20.00‡
Chicago	8.25	12.75	1.96	2.63	1.68	1.45*hf*	1.50*hf*	1.50*hf*	.25*f*	21.00*f*
Cincinnati	8.25	12.75	1.65	2.85	1.55	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	8.25	12.75	1.90	2.60	1.60	1.75	1.50*h*	1.50*h*	.35	21.00
Dallas	8.25	13.50	1.88	2.11	....	2.75*h*	2.60*h*	2.70*h*	.275	34.00
Denver	8.75	13.25	1.65	2.40	.17*l*	2.45	4.00	3.00	.35	18.00
Detroit	8.25	12.75	1.75	2.75	1.50	2.40	2.50	2.50	.35	26.00
Kansas City	8.25	12.875	2.15*g*	2.40*g*	1.67*g*	1.93	2.09	2.09	.25	25.00
Los Angeles	8.50	13.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	8.25	12.875	....	....	....	1.75*i*	1.50*hi*	1.50*hi*	.29	21.00
Montreal	9.25	9.00	2.25	2.80	2.35	2.53	1.68	1.78	.70	1.68*k*
New York	8.25	12.75	1.88	2.55	1.60	1.75	1.50*h*	1.50*h*	.23	24.00
Philadelphia	8.25	12.75	....	....	....	1.92*e*	1.99*he*	1.99*he*	.41*e*	21.00
Pittsburgh	8.25	12.75	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	8.25	12.75	1.90/2.00	2.60/2.85	1.60/2.00	2.04	1.50	1.50	.23	21.00
San Francisco	8.50	13.00	1.80	2.75	1.10/2.00	1.65	2.26	2.26	.28	17.00
Seattle	8.50	13.25	1.80	2.60	....	1.81	1.30/2.00	1.75	.35	28.00*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per 100 lb. *l* Per lb.

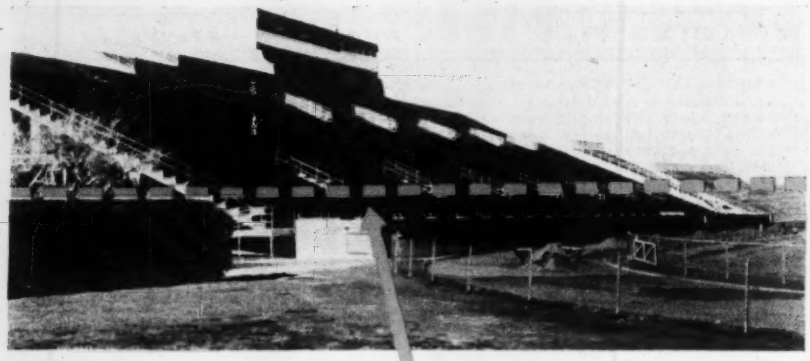
SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor—Building	Common Labor—Heavy Const.
Atlanta	$1.25	$1.00	$1.375	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.65	1.50	1.375	.625	.625
Birmingham	1.50	1.125	1.375	1.125	1.00	.40	.40
Boston	1.50	1.375	1.625	1.375/1.625	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.70	1.70	1.025	1.025
Cincinnati	1.625	1.45	1.55	1.375/1.525	1.625	.75	.75
Cleveland	1.625	1.375	1.50	1.50/1.75	1.50	.90	.90
Dallas	1.50	1.00	1.25	1.00	1.50	.40/.50	.40/.50
Denver	1.65*b*	1.43*b*	1.43*b*	1.43*b*	1.50*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.625	1.50	1.55	.60/.75	.60/.775
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.50	1.25	1.375	1.375	1.40	.40	.50
New York	2.00*b*	1.85*b*	2.00	2.00*b*	2.00*e*	1.031	.875/.95
Philadelphia	1.65*b*	1.40	1.65	1.50	1.75	.70	.70
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.50	1.75	1.50/2.00	1.75	.45/.875	.875
San Francisco	1.75*c*	1.25	1.60	1.50	1.60*c*	.813	.813
Seattle	1.60*c*	1.25	1.50*c*	1.50*c*	1.60*c*	.90*c*	.90*c*
Montreal	.80	.70	.75	.65	.80	.45	.40

b 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk.



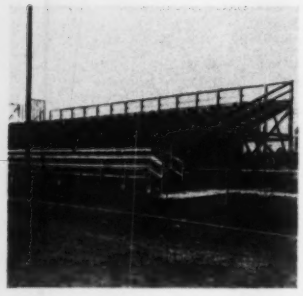
ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) **$1.480**
ENR Common Average: $0.711



HERE'S A

Line of Attack

FOR SCORING ON BOTH STRUCTURAL ENDURANCE AND LOW COST



Using Wolmanized Lumber in a portion of the Rice Institute Stadium (above) proved so satisfactory that the material was applied throughout; below, the stadium of Pasadena High School, Pasadena, Texas, built wholly of Wolmanized Lumber.

Weather, and weathering, constitute the problem in stadium upkeep. Wolmanized Lumber* provides the effective attack on that problem. Wolmanized Lumber is protected against decay and termite damage, so it can be used to make seats and structural parts which last longer, cost less.

Certain unique advantages of Wolmanized Lumber are important for stadium construction. The material is clean, dry, odorless, suitable for use with or without paint. And it is thoroughly dependable, is in fact the only material of its kind which is always *pressure*-treated according to one standard set of specifications, and is sold under one identifying name from coast to coast.

These same advantages have led to the use of Wolmanized Lumber for bridges, industrial buildings, piers, tunnels, and scores of other types of structure for which endurance at low cost is desired. The booklet "Wood Preservation" describes these uses. Ask us for a copy. AMERICAN LUMBER & TREATING CO., 1649 McCormick Building, Chicago.

*Registered Trade-mark

WOLMANIZED LUMBER

(Continued from p. 10)

the assessment practice prevailing in the county.

The court held that if there was no ready market for the used machinery on the job but only at some central market and by sale through a broker, what the seller could net within a reasonable time represented the market value. Costs of transportation to markets where the property could be sold, brokerage, fees to dealers, storage charges until sold and interest on money until sold were taken into consideration. The decision reduced the assessed value of the property from $212,000 to $76,775. The decision, which is subject to review on appeal, was made by Judge Hansen, Los Angeles Superior Court, in July 1940.

Concrete Hinges Tested

In concrete bridges, especially those of long span, some form of articulation is desirable at the base of vertical members, in order to avoid high deformation stresses resulting from temperature changes and shrinkage of concrete. As part of an investigation of rigid-frame bridge design, tests of structural hinges of reinforced-concrete have been made at the University of Illinois, in cooperation with the Portland Cement Association. These tests are reported by Ralph W. Kluge in Bulletin 322 of the engineering experiment station of the University.

While no definite conclusions are presented, important results of the tests may be summarized as follows: (1) The measured strength of hinges under vertical load was equal to or even greater than the computed strength; (2) certain types of hinges tested under oblique load compared favorably with the requirements of rigid-frame highway bridges of medium spans, and with improvements in hinge details higher strengths may be expected; (3) the hinges were sufficiently flexible to permit an angular rotation as large as 0.004 radian without structural damage; (4) there was no evidence of deterioration under repeated rotation after 10,000 reversals of the above movement; (5) ultimate strength of the hinges was not affected materially by combining this forced rotation with a vertical load.

(Continued on p. 118)

New AIR-POWER Unit

Makes Small Jobs More Profitable

60 CU. FT. (cubic feet free air per minute actually delivered)

Two-Stage Portable

This handy little compressor known as the D-60—and the air tools it will operate—make an ideal Compressed-Air Outfit for odd jobs and small contracts. You can take it anywhere—anytime. It's a gasoline unit ready to go to work without waiting for power connections.

Being small and inexpensive, the D-60 enables many contractors and municipal service departments to speed up their work by putting Air Tools on their jobs.

On big contracts, the D-60 can handle the smaller or urgent here-and-there jobs, eliminating transportation and tie-up of larger units.

The D-60 has the same high quality of design and construction which is characteristic of the larger I-R Portables. The compressor was designed for one purpose—to compress air. The engine was engineered to fit it. These are built together as one rigid, unified assembly. Separate crankcases and lubrication systems eliminate the hazards of unburned gasoline fumes getting into the compressed air. Engine and compressor each have their own properly engineered cooling systems. Because of its "built-in reliability", the D-60 will still be on the job after years of service.

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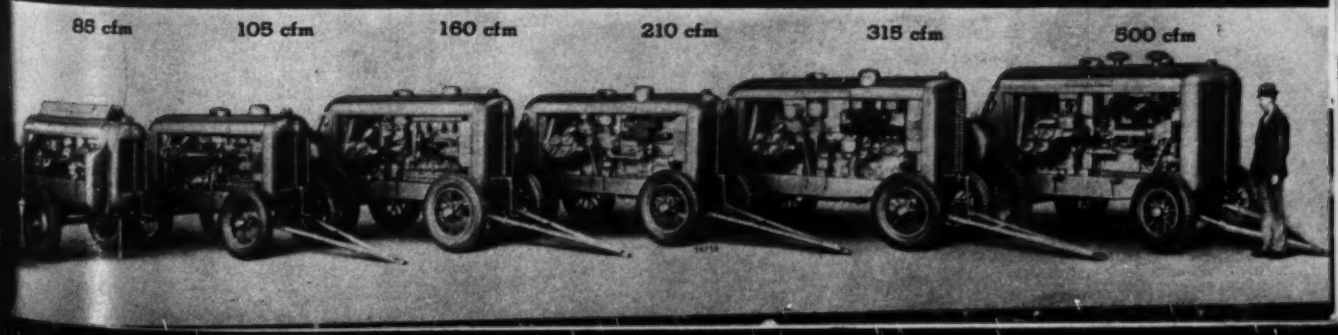

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"Incidentally, BW equipment has cut our electric current costs ⅔. And, by using BW sheets cut to the exact size of our tracings, we save the time, cost and waste of trimming."

Typical of the Bruning equipment which helps make such savings possible is this new Bruning Mercury "75" Printer. It operates at a speed of 20 feet per minute, with medium speed BW paper—uses only 4,400 watts. Its new type mercury vapor quartz lamp has a guaranteed lamp life of 1000 hours! Mail the coupon for free booklet!

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(Continued from p. 116)

Water Treatment at St. Paul

Filtration of water at St. Paul, Minn., in 1939, averaged a cost of $8.80 per million gallons filtered, for a daily average of 23.19 mg treated and filtered, as shown by the annual report of the Board of Water Commissioners. Filter effluent averaged 24.12 mg daily, and water delivered to city mains, 22.75 mg. Backwash water for the filters was 1.91 per cent of the total amount of water, and the periods between washings averaged 52 hours.

Treatment of the water averaged: aluminum sulphate, 21.62 grains per gal.; liquid chlorine, 0.89, and ammonium sulphate, 0.15. The corresponding costs for the three chemicals were $2.29, 39c., and 7c., or a total of $2.75 per mg.

A filter addition, with water softening equipment, was completed in 1939, and 2,700 ft. of 20-in. steel pipe was laid, being tunneled under the union station tracks and the Mississippi River. This pipe replaced a 16-in. cast-iron pipeline laid in 1888, and leakage from which in 1939 was estimated at 400 mg. Collection of sewer rentals was begun by the Board on Jan. 1, 1939, under order from the City Council.

"Safe Water" Signs Must be Conspicuous

From a survey of roadside "Water Supply Approved" signs at cities having approved supplies, the South Dakota State Board of Health finds that these are not always so located as to attract attention of the traveling public. In some states these signs are often located on the post carrying the name of the city. Where this cannot be done, the sign might be placed on a post directly behind and above the city sign, thus avoiding an additional obstruction to highway maintenance equipment. Where the signs were found defaced, they were always located in the extreme outskirts or even outside the city limits. The Board, in its bulletin *The Clarifier*, offers these suggestions for the consideration of cities which have "approved" water supplies, and urges their adoption because people are interested in finding safe water.